A STUDY ON SOURCES AND CONSEQUENCE OF SCIENCE TEACHERS' SELF-EFFICACY

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

MERVE PEHLİVAN

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
SCIENCE EDUCATION IN MATHEMATICS AND SCIENCE EDUCATION

FEBRUARY 2022

Approval of the thesis:

A STUDY ON SOURCES AND CONSEQUENCE OF SCIENCE TEACHERS' SELF-EFFICACY

submitted by **MERVE PEHLİVAN** in partial fulfillment of the requirements for the degree of **Master of Science in Science Education in Mathematics and Science Education, Middle East Technical University** by,

Prof. Dr. Halil Kalıpçılar
Dean, Graduate School of **Natural and Applied Sciences** _____

Prof. Dr. Erdinç Çakıroğlu
Head of the Department, **Mathematics and Science Education** _____

Prof. Dr. Semra Sungur
Supervisor, **Mathematics and Science Education, METU** _____

Examining Committee Members:

Prof. Dr. Ceren Öztekin
Mathematics and Science Education, METU _____

Prof. Dr. Semra Sungur
Mathematics and Science Education, METU _____

Dr. Öğr. Ü. Dekant Kıran
Mathematics and Science Education, Tokat Gaziosmanpaşa Uni. _____

Date: 11.02.2022

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name Last name : Merve Pehlivan

Signature :

ABSTRACT

A STUDY ON SOURCES AND CONSEQUENCE OF SCIENCE TEACHERS' SELF-EFFICACY

Pehlivan, Merve
Master of Science, Science Education in Mathemetics and Science Education
Supervisor: Prof. Dr. Semra Sungur

February 2022, 187 pages

The purpose of this study was to investigate the relationship between sources and the consequence of science teachers' self-efficacy. Science teachers' self-efficacy was measured in terms of self-efficacy for student engagement, classroom management, and instructional strategies. As sources of self-efficacy Bandura's hypothesized sources (i.e. mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states), years of experience, implicit beliefs of science ability, and job satisfaction were explored. As consequence of teacher self-efficacy, teachers' mental models regarding their teaching beliefs were examined. Moreover, the study was extended by examining whether teachers' sense of self-efficacy beliefs differ with respect to their teaching styles, determined through their mental models. In the study, 192 in-service science teachers participated and the data were collected through the administrtion of self-report instruments, namely the Teacher Sense of Efficacy Scale (TSES) , Teacher Job Satisfaction Scale (TJSS), Implicit Theory of Science Ability Scale (ITSA), Sources of Self-efficacy Inventory (SOSI), and the Draw a Science Teacher Test-Checklist (DASST-C). In order to investigate how well the proposed sources predicted teachers' sense of self-efficacy, three different multiple regression analyses for each self-efficacy dimension were conducted.

Additionally, to reveal how well teachers' sense of self-efficacy predicts the consequence one more multiple regression analysis was carried out. Moreover, teachers' sense of self-efficacy beliefs with respect to their teaching styles were examined through multivaritate analysis of variance (MANOVA). Results demonstrated that mastery experience and implicit theory of science ability were found as positive significant predictors, whereas physiological and emotional states were found as negative significant predictor of teachers' sense of self-efficacy for all sub-dimensions. In addition, in-service science teachers' vicarious experiences were also found as negative significant predictor of their sense of self-efficacy for classroom management. Among all proposed sources, mastery experience made the largest contribution of prediction of teachers' sense of self-efficacy for all sub-dimensions. On the other hand, job satisfaction, years of teaching experience, and verbal persuasion were not found as statistically significant predictor for any teacher self-efficacy sub-dimension. Moreover, results also indicated that the combination of teachers' sense of self-efficacy sub-dimensions significantly explained 6.9 % of the variance of in-service science teachers' mental models regarding their teaching beliefs. Additionally, teachers with exploratory teaching style had significantly high levels of self-efficacy for student engagement and for instructional strategies compared to teachers with explicit teaching style.

Keywords: Inservice Science Teachers, Teacher Self-Efficacy, Sources of Self-efficay, Years of Teaching Experience, Teacher Job Satisfaction, Implicit Theory of Science Ability, Mental Model, Teaching Style

ÖZ

FEN BİLİMLERİ ÖĞRETMENLERİNİN ÖZ-YETERLİK ALGILARININ KAYNAKLARI VE SONUCUNA İLİŞKİN BİR ÇALIŞMA

Pehlivan, Merve
Yüksek Lisans, Fen Bilimleri Eğitimi, Matematik ve Fen Bilimleri Eğitimi
Tez Yöneticisi: Prof. Dr. Semra Sungur

Şubat 2022, 187 sayfa

Bu çalışmanın amacı, ortaokul fen bilimleri öğretmenlerinin öz-yeterlilik algılarının kaynakları ve sonuçları arasındaki ilişkiyi araştırmaktır. Öz-yeterlilik kaynakları olarak; Bandura'nın öz-yeterlilik kaynakları (doğrudan yaşantılar, dolaylı yaşantılar, sözel ikna, fizyolojik ve duygusal durumlar), iş deneyimi, fen yeteneğine ilişkin örtük teoriler ve iş tatmini dikkate alınarak ve 192 fen bilimleri öğretmenlerine öz-bildirim ölçekleri uygulanmıştır. Bunun yanı sıra, öz-yeterlilik algılarınına bağlı olarak fen bilimleri öğretmenlerinin derslerinde öğrenci merkezli mi yoksa öğretmen merkezli bir eğitim yöntemi uyguladığı incelenmiştir. Bu amaçla, veri toplamak için Fen Öğretmeni Çizim Testi kullanılmıştır. Önerilen kaynakların öğretmenlerin öz yeterlik duygularını ne kadar iyi yordadığını araştırmak için her bir öz yeterlik boyutu için üç farklı çoklu regresyon analizi yapılmıştır. Ayrıca öğretmenlerin öz-yeterlik duygularının sonucu ne kadar iyi yordadığını ortaya çıkarmak için bir çoklu regresyon analizi daha yapılmıştır. Buna ek olarak, öğretmenlerin öğretim stillerine göre öz-yeterlik algıları çok değişkenli varyans analizi (MANOVA) ile incelenmiştir. Elde edilen sonuçlara göre doğrudan yaşantılar ve fen yeteneği örtük teoriler tüm alt boyutlar için öğretmenlerin öz-yeterlik duygularının pozitif anlamlı yordayıcıları olarak bulunmuştur. Ayrıca, fizyolojik ve duygusal durumların negatif

anlamlı yordayıcıları olarak bulunmuştur. Buna ek olarak, hizmet içi fen öğretmenlerinin dolaylı deneyimleri de sınıf yönetimine yönelik öz-yeterlik duygularının negatif anlamlı yordayıcıları olarak bulunmuştur. İncelenen tüm kaynaklar arasında, tüm alt boyutlar için öğretmenlerin öz-yeterlik algısını yordamada en büyük katkıyı doğrudan yaşantılar sağlamıştır. Öte yandan, iş doyumu, öğretmenlik deneyim yılı ve sözel ikna, öğretmen öz yeterlik alt boyutlarının herhangi biri için istatistiksel olarak anlamlı bir yordayıcı olmadığı bulunmuştur. Ayrıca, sonuçlar öğretmenlerin öz-yeterlik duygusu alt boyutlarının birleşiminin, hizmet içi fen öğretmenlerinin öğretim inançlarına ilişkin zihinsel modellerinin varyansının %6.9'unu anlamlı bir şekilde açıkladığını göstermiştir. Ek olarak, keşfedici öğretim stiline sahip öğretmenlerin öğrenci katılımı ve öğretim stratejilerilerinin kullanımı için önemli ölçüde yüksek özyeterliğe sahip olduğu bulunmuştur.

Anahtar Kelimeler: Fen Bilimleri Öğretmenleri, Fen Öğretimine Yönelik Öz-yeterlilik, Öz-yeterlilik Kaynakları, İş Deneyimi, İş Doyumu, Fen Yeteneğine İlişkin Örtük Teoriler, Zihinsel Model, Öğretim Stili

To My Mom and Dad

ACKNOWLEDGMENTS

First and foremost, I would like to begin my acknowledgments by expressing my deepest and greatest gratitude to my supervisor, Prof. Dr. Semra Sungur, for her valuable support and guidance throughout my study. She patiently encouraged me and supported me whenever I needed and felt lost in the process. Your perfect and quick guidance made it easier for me to be able to write this thesis. Thank you sincerely.

Secondly, I would like to thank my committee members Prof. Dr. Ceren Öztekin and Dr. Öğr. Ü. Dekant Kıran for their valuable feedback and suggestions to improve my thesis. I am grateful for your critiques which helped me to make my study better.

I also would like to express my sincere appreciation to 192 teachers who agreed to participate in the study. I also would like to say my special thanks to the school principals who hosted me well in their school and offered me plenty of tea and coffee.

My special heartfelt thanks go to my dear husband, Rıdvan Pehlivan. Your presence and never-ending support made me stronger in this long writing process. I feel fortunate with you. I love you. Your turn is next! See you in our doctoral dissertation!

My dear big family, words are not enough to describe what you mean to me. I would like to thank my parents, Saber and Mehmet Sezgintürk. You always believed in me and gave your never-ending love and support with no holds barred.I would like to thank to my siblings Selma Canbaz and her Husband İrfan Canbaz, Mine Özlü and her husband Gökhan Özlü, my brother Salih Sezgintürk and his wife Hanife Sezgintürk, my nephews Mehmet Ali, Abdulkadir, Bilal, Yılmaz, and my nieces

Şevval, Zeynep, and Tuana. Your trust and support never disappeared. Thank you very much.

I would also like to thank all the healthcare personnel, especially my sister Selma Canbaz and her husband İrfan Canbaz, who gave their lives to our nation by doing their heroic and self-sacrificing duty in these days when the whole world is going through a difficult pandemic process.

Lastly, I also would like to thank my close friends Ceren Fırat, Mehmet Yıldız, Pelin Özkan Altıntaş, Ünzile Elif Karaca Uğur, Selin Uçar Özsoy and her husband Mahmut Özsoy. You also always supported and motivated me in this period. When I was disappointed, your phone calls and advice were helpful. I am very lucky to have friends like you. Specifically, Mehmet Yıldız, your experiences and feedback always opened my sight. I went through the data collection process due to the pandemic; I almost gave up the thesis, but he said that these days would pass, and we will laugh while writing the acknowledgments section. Now, he and I finally finished the thesis. He was right. Thank you.

TABLE OF CONTENTS

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

TSES : Teachers' Sense of Efficacy Scale

TJSS : Teacher Job Satisfaction Scale

SOSI : Sources of Self-efficacy Inventory

ITSAS : Implicit Theory of Science Ability Scale

DASTT-C : Draw A Science Teacher Test Cheklist

CHAPTER 1

INTRODUCTION

Based on Bandura's Social Cognitive Theory (1977), teaching self-efficacy is defined as "teacher's beliefs in his or her own ability to organize and execute courses of action essential to successfully achieving the specific teaching tasks in specific situations" (Tschannen-Moran, Hoy & Hoy, 1998, p.207). According to Tschannen-Moran et al. (1998), teachers' teaching self-efficacy can be categorized into three dimensions: (a) self-efficacy for instructional strategies, i.e., confidence in applying appropriate teaching strategies, (b) self-efficacy for classroom management, i.e., confidence in using effective classroom management methods, and (c) self-efficacy for student engagement, i.e., confidence in utilizing strategies to keep students engaged in class. Teaching self-efficacy can be considered as a strong belief that can build and direct ideas and actions while teaching (Pamuk, Sungur & Oztekin, 2017). Accordingly, teachers' teaching self-efficacy is associated with many desired teacher outcomes and student outcomes. Indeed, numerous studies revealed that teaching self-efficacy affects various student outcomes such as student achievement (Caprara, Barbaranelli, Steca, & Malone, 2006; Guo, Connor, Yang, Roehrig, & Morrison, 2012; Woolfolk-Hoy & Davis, 2009), student motivation (Ashton & Webb, 1986), and student self-efficacy (Ross, Hogaboam-Gray, & Hannay, 2001). It is also reported that teaching self-efficacy was positively linked to students' behavioral, cognitive and emotional engagement (van Uden, Ritzen, & Pieters, 2014).

Teachers' teaching self-efficacy was found to affect students' achievement and motivation in different ways. For example, the literature review indicated that teachers with higher self-efficacy plan, organize, and are more passionate about teaching (Allinder, 1994). They are more likely to set challenging goals for

themselves and make an effort to accomplish these goals (Schwarzer & Hallum, 2008). They persist longer with students who struggle and are less critical about student errors (Ashton & Webb, 1986; Gimbson & Dembo, 1984). These teachers are more likely to use effective classroom management strategies in a humanistic way (Woolfolk & Hoy, 1990) and control discipline problems (Chacón, 2005). Additionally, teachers with a greater sense of teaching self-efficacy tend to address students' needs better (Ashton & Webb, 1986), to be open to new ideas (Allinder, 1994), and to try practicing new methods to meet students' needs better (Geijel, Seegers, Stoel, and Krüger, 2009).

Moreover, teachers' teaching self-efficacy may influence their teaching beliefs regarding student-centered or teacher-centered practices and their teaching styles concerning explicit, conceptual, or exploratory (Finson, Pedersen, and Thomas 2006; Thomas, Pedersen, and Finson, 2001). Thomas et al. (2001) carefully defined these three major teaching style terms. The first is the explicit teaching style, which consists of mainly teacher-centered teaching methods. The content of the knowledge is mainly transmitted to the student by the teacher. In the science education context, the explicit teaching style can be considered as teachers are responsible for managing and delivering content knowledge to students and stressing science's factual and descriptive nature of science (Simmons et al., 1999). The second is the conceptual teaching style, where the teacher provides the content directly, and the students interact with the materials. In the science education context, science teachers highlight the explanatory nature of science, utilize many teacher-centered teaching methods, and encourage student-student interactions (Simmons et al., 1999). The third teaching style is exploratory, which consists of mainly student-centered teaching methods. The teacher has a facilitator or guidance role, and students actively engage with the context. In the science education context, science teachers emphasize the nature of science as inquiry, utilize more inquiry-based teaching methods, and encourage students to make analyses (Simmons et al., 1999).

Thomas et al. (2001) developed the Draw-A- Science Teacher Test- Checklist (DASTT-C) instrument to examine teachers' mental models about their teaching beliefs and teaching styles. Through this instrument, teachers draw their classroom environment by considering what students and teachers are doing. According to the checklist, part of the instrument, researchers rate the drawings and then decide the teachers' teaching beliefs and styles. Higher scores on the instrument indicate more teacher-centered beliefs. The instrument was utilized in a study conducted by Görecek Baybars (2017) to determine mental models of preservice teachers' beliefs about science teaching. The data was collected from 72 first-year preservice science teachers studying at Elementary Science Education in Turkey via the DASTT-C instrument and semi-structured interview questions. According to the analyses, it was reported that there are mainly teacher-centered drawings and expressions.

In another example, Ambusaidi and Al-Balushi (2012) conducted a longitudinal study to determine the science teaching beliefs of prospective science teachers in Oman about science teaching using the DASTT-C instrument. The data was collected from 45 prospective teachers three times before the science method course, after finishing this course, and also after finishing the internship. The study demonstrated that after taking the course, the teachers' mental models shift from teacher-centered teaching beliefs to intermediate-level student-centered teaching beliefs. Also, it was found that there was no significant change after the internship. Moreover, the results revealed that prospective science teachers were at the conceptual teaching style among the three teaching styles. According to the results, researchers discussed the science method course's effectiveness and recommended implications.

In the literature there are many studies, researchers investigate the relationship between science teachers' self-efficacy beliefs and their teaching styles by using the

DASTT-C instrument (Finson, Riggs, and Jesunathadas, 2000; Feyzioğlu, Feyzioğlu, and Küçükçıngı, 2014; Rubeck & Enochs, 1990; Finson et al., 2006; Sibel, 2017). When the existing studies are examined, there is a common and significant result which is that teachers with high self-efficacy are more willing to practice student-centered teaching beliefs using exploratory teaching style, whereas teachers with low self-efficacy tend to practice teacher-centered beliefs using explicit-oriented teaching style (Finson et al., 2000; Finson et al., 2006; Rubeck & Enochs, 1990; Sibel, 2017). For example, a study was conducted by Sibel (2017) to investigate primary school teacher candidates' self-efficacy and also mental models for science teaching. The participants were 108 pre-service primary school teachers in Turkey. The data was collected from the participants by using the Self-Efficacy Beliefs Inventory for Prospective Primary School Teachers in teaching science (Riggs and Enochs, 1990) developed by Riggs and Enochs (1990) and the DASTT-C instrument (Thomas et al., 2001). The results also indicated that the pre-service teachers with higher teaching self-efficacy tend to move from teacher-centered to student-centered education in science education. The results showed a significant relationship between pre-service teachers' mental models for science teaching and their self-efficacy beliefs for science teaching.

In sum, however, review of the literature shows that most of the existing research is conducted with preservice teachers (Ambusaidi & Al-Balushi, 2012; Feyzioğlu et al., 2014; Finson et al., 2000; Finson et al., 2006; Minogue, 2010; Görecek Baybars, 2017; Sibel 2017; Tatar, Yildiz Feyzioglu, Buldur & Akpinar, 2012) rather than inservice teachers especially in Turkey. Moreover, most of them did not investigate the link between teachers' teaching self-efficacy and teaching styles (Ambusaidi & Al-Balushi, 2012; Görecek Baybars, 2017; Minogue, 2010; Tatar et al., 2012). However, according to the relevant literature, teaching self-efficacy is expected to relate to teaching beliefs (student-centered or teacher-centered) and teaching styles such as explicit, conceptual, or exploratory. In the present study, teaching beliefs will

be examined as a consequence of science teachers' teaching self-efficacy. In addition, teachers' self-efficacy will be investigated concerning teaching styles. For this purpose, by using the DASTT-C instrument, in-service science teachers' drawings about their classroom environment will be analyzed.

In the present study, besides the consequence of teacher self-efficacy, this study will explain how teachers' teaching self-efficacy is formed. According to Bandura (1997), efficacy beliefs are developed as a result of the cognitive process that involves selecting and weighing different sources of efficacy information. Based on the literature review, teaching self-efficacy sources can be explored in terms of Bandura's hypothesized four sources, job satisfaction, years of teaching experience, and teachers' implicit theory of science ability (Bandura, 1997; Hoy, 2004; Kıran, 2021; Kalkan, 2020; Kiran & Sungur, 2018; Klassen & Chiu, 2010; Yerdelen & Sungur, 2019; Wolters & Dougherty, 2017). Therefore, in the present study, these sources will be regarded as potential sources of science teachers' teaching self-efficacy. According to Bandura (1997), teachers construct their teaching self-efficacy by interpreting information obtained through four sources: mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states. Mastery experience is the most important source in shaping self-efficacy among these hypothesized sources since it contains teachers' interpretations of their past experiences (Bandura, 1997; Hoy, 2004). If teachers evaluate their past experiences as successful, their self-efficacy beliefs tend to increase. On the other hand, when they view their experiences as a failure, their self-efficacy can be diminished (Bandura, 1997; Capa-Aydın, Uzuntiryaki-Kondakci, & Ceylandag, 2018). Another source is the vicarious experience which is gained by observing or modeling others' performance. If the model performs well, the observer teacher believes that “I can do as well.” which improves teacher self-efficacy (Bandura, 1997). However, the similarity between the model and observer teacher plays a key role (Bandura, 1997). The vicarious experience is also an important source,

especially when teachers have lack years of teaching experience (Bandura, 1997; Schunk, 2004). Moreover, teachers can also obtain self-efficacy information through verbal persuasion sources, which involves verbal feedback from others such as colleagues, family, or students (Bandura, 1997). Finally, teachers can also receive information about their teaching self-efficacy from their physiological and emotional states (Bandura, 1997). Anxiety, mood, fear, and stress experienced by teachers can influence their judgments about their capabilities and also their teaching practices.

Many research suggests that Bandura's hypothesized four sources of self-efficacy are important factors affecting teaching self-efficacy for classroom management, student engagement, and instructional strategies. For example, Kıran (2021) conducted quantitative research on science teachers' sources of teaching self-efficacy. The participants of the study were 238 final-year pre-service science teachers. The data was collected through the Teachers' Sense of Self-efficacy Scale (Tschannen- Moran & Woolfolk-Hoy, 2001) and Sources of Self-Efficacy Inventory (Kieffer & Hanson, 2000). According to regression analyses, results show that mastery experiences were the primary source of teaching self-efficacy for classroom management, student engagement, and instructional strategies. The second significant source was verbal persuasion. Teachers' emotional state source negatively contributed to their teaching self-efficacy for all dimensions. Vicarious experiences did not contribute to the teachers' teaching self-efficacy for any dimension. Actually, it is not surprising because the participants of the study are not in-service teachers. Since they do not have a chance to observe, evaluate, compare, and model other teachers, their vicarious experience source was not a significant predictor of teaching self-efficacy. Kıran (2021) also suggested that more attention should be given to teacher preparation programs at the university, especially for microteaching courses.

Other researchers also offered that job satisfaction is another factor that influences teachers' teaching self-efficacy for classroom management, instructional strategies,

and student engagement (Buluç & Demir, 2015; Caprara, Barbaranelli, Steca, & Malone, 2006; Kiran & Sungur, 2018; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2010). Teacher job satisfaction is defined as “teachers' affective reaction to their work and their teaching role” (Skaalvik & Skaalvik, 2017, p.154). According to the literature review, teacher job satisfaction is an important source affecting teacher performance in the classroom (Ollube, 2006). Teachers who are not satisfied with their jobs have a low sense of belonging to the profession (Evans, 2001). Whereas teachers with a high sense of job satisfaction are more successful in solving problems, managing time, encouraging students, and creating an environment that supports learning in the classroom (Klussman et al., 2008; Demirtaş, 2010, Kiran & Sungur, 2018).

Moreover, Caprara et al. (2006) stated that job satisfaction guides teachers' self-efficacy. A meta-analysis study conducted by Kalkan (2020) investigated the relationship between teaching self-efficacy and job satisfaction by examining 35 studies between 2000 and 2018. The result of the study shows that although experience year, school location, school type, and scale type used in these studies can change the effect size, it was determined that there is a positive relationship between teacher self-efficacy and job satisfaction. Another study was conducted by Klassen and Chiu (2010) with 1430 in-service teachers. The results showed positive relations between teachers' self-efficacy for instructional strategies, classroom management, and job satisfaction. In contrast, there was no association between teachers' teaching self-efficacy for student engagement and job satisfaction.

The teachers' years of teaching experience is also an alternate factor that affects teaching self-efficacy for classroom management, instructional strategies, and student engagement (Campbell, 1996; Poulou, Reddy, & Dudek, 2019; Wolters & Daugherty, 2017). For example, Wolters and Daugherty (2017) stated that teachers with more years of experience are more efficacious in implementing new teaching

methods and teaching the curriculum. In a study conducted on teachers from preschool to twentieth grade, Wolters and Daugherty (2007) reported that there is a positive relationship between years of teaching experience and teacher self-efficacy. The research conducted on preschool teachers, Bullock, Coplan, and Bosacki (2015) stated that teachers with more years of teaching experience had higher teacher self-efficacy for classroom management.

Moreover, Poulou et al. (2019) conducted a study on 58 in-service teachers with experiences between 11 and 20 years to investigate teachers' perceptions of self-efficacy and actual instructional and behavior management practices. The results show a curvilinear relationship between teachers' self-efficacy and years of teaching experience, which means that teacher self-efficacy for all dimensions increases in early and mid-career levels and then declines in a later career. This result is consistent with the study conducted by Klassen and Chiu (2010).

In addition, according to the relevant literature, teachers' implicit theory of science ability emerges as another potential source of teachers' self-efficacy. Teachers' implicit theory of science ability is defined as "science teachers' beliefs about whether students' ability in science can change" (Yerdelen & Sungur, 2019, p.96). Teachers' implicit theories can be incremental or entity for science ability. Some teachers who hold the entity theory believe that students' science ability is a fixed trait, and they may feel that there is no control over the students' learning (Dweck, 1996). These teachers are expected to have lower teacher self-efficacy (Leroy, Bressoux, Sarrazin, & Trouilloud, 2007). These teachers worry about failure, tend to choose easy tasks, and their teaching goal is to increase student performance (Dweck & Bempetchat, 1998; Klassen and Chiu, 2010; Tamir, John, Srivastava & Gross, 2007). Conversely, some teachers who hold incremental theory believe that students'

science ability is a malleable trait, and they may think that they can improve it (Dweck, 1996; Yerdelen & Sungur, 2019). Teachers who hold incremental theory have higher teacher self-efficacy (Leroy et al., 2007). These teachers set challenging goals, persist in challenging goals, tend to apply new teaching methods, and their teaching goal is to increase student learning (Dweck & Bempetchat, 1998; Klassen and Chiu, 2010; Tamir et al., 2007).

Leroy et al. (2007) provide in-depth analyses on teacher self-efficacy to support autonomy climate in the classroom regarding teachers' implicit theories, their seniority, and their perceptions of pressures at work. The research was conducted with 336 elementary teachers. The results showed that teachers with the incremental theory for students' ability tended to have higher levels of self-efficacy. Nevertheless, there was no indirect impact of incremental theory on autonomy-supportive climate through teaching self-efficacy. Also, entity teachers were less likely to create autonomy-supportive climates, which means that these teachers' classroom climate does not effectively support students' motivational needs.

In general, all studies reviewed here support the notion that Bandura's hypothesized four sources, job satisfaction, years of teaching experience, and implicit theories of science ability are related to teaching self-efficacy. Based on the relevant literature and Bandura's suggestions, the present study aimed at analyzing sources and consequences of science teachers' teaching self-efficacy. In the study, as sources of science teacher's self-efficacy, Bandura's hypothesized four sources, job satisfaction, years of teaching experience, and implicit theories of science ability were examined. On the other hand, as consequences of science teachers' teaching self-efficacy, mental models regarding their teaching beliefs, such as teacher-centered or student-centered, were investigated. Moreover, it was also analyzed whether science teachers' teaching self-efficacy differs with respect to their mental models regarding their teaching styles (i.e., exploratory, conceptual, or explicit).

1.1 Significance of the Study

Teaching self-efficacy has played a key role in educational settings over the past three decades. Many researchers reported that teachers' judgments about their capabilities affect their goal settings, effort regulations, persistence, motivation, teaching beliefs regarding student-centered or teacher-centered, and teaching styles such as explicit, conceptual, or exploratory. Moreover, teaching self-efficacy has a great impact on teaching practices in terms of classroom management, instructional strategies, and student engagement (Tschannen-Moran & Woolfolk Hoy, 2001). Hence, it is essential to conduct studies providing an in-depth analysis of teaching self-efficacy with an ultimate aim of improving teaching and learning process . In the science education field, many researchers asserted that teaching self-efficacy is a domain-specific construct in their studies (Bandura, 1997; Capa & Uzuntiryaki, 2009; Sezgintürk & Sungur, 2020; Tuan et al., 1997; Wang et al., 2018). However, little is known how in-service middle school teachers develop their teaching self-efficacy in science education. Therefore, this study focuses on science teachers' teaching self-efficacy by examining its potential sources and consequence in a single study. Although available literature provides similar studies, this study combines the variables which emerge as potential sources of self-efficacy in single regression models. Therefore, this study allows examining the unique contribution of each variable in the presence of other variables. Accordingly, the results have the potential to produce more accurate results with implications for teacher education programs, science educators, and researchers.

Additionally, this study is significant since it allows to determine how science teachers' teaching self-efficacy can be improved. According to the social cognitive theory, efficacy beliefs are formed when individuals weigh and select different self-efficacy sources as a result of the cognitive process. Hence, it is necessary to reveal the sources of teaching self-sources as much as possible. Therefore, more specifically, this study aims to examine years of teaching experience, job

satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, physiological and emotional states as potential sources of teaching self-efficacy. In fact, the relevant literature states that sources of teaching self-efficacy information indirectly influence students' academic achievement through the teachers' teaching self-efficacy (Mohamadi & Asadzadeh, 2012; Mohamadi et al., 2010). Hence, conducting a study on sources of teaching self-efficacy is also vital to improve students' science achievement indirectly, as well. Turkish middle school students' science achievement TIMMS (2019) reports (Trends in International Mathematics and Science Study) indicate that Turkey has reached the highest performance regarding eight-grade science achievement in TIMMS 2019 application compared to 1999, 2007, 2011, and 2015. Considering the percentages of students who have reached the international proficiency levels, it concluded that only 6 % of students are at the advanced levels, 19 % at thigh level, however; 75 of the students at the medium and low levels in terms of science success in the international groups. Therefore, conducting research on science teachers' teaching self-efficacy can be considered as an important step to take necessary actions to improve students' science achievement since teaching self-efficacy has great impact on teachers' beliefs and practices.

At this point, another significance of the study emerges: in this study science teachers' mental models regarding teaching beliefs and teaching styles were also considered. In the current study, teachers' mental models are investigated using the DASTT-C instrument which provides an opportunity to make a more comprehensive analysis by asking teachers to draw pictures of their classroom environments. The DASTT-C instrument helps to create deeper understandings of teachers' perceptions, ideas, beliefs, and personal theories about how to teach elementary science through drawings of their mental models (Thomas, Pedersen, & Finson, 2001). The instrument was widely utilized both for in-service and pre-service teachers in different cultures and also used to examine the relationship with various contexts such as the self-efficacy and nature of science (Ambusaidi & Balushi, 2011; Bilican,

Ozdem-Yılmaz, & Oztekin, 2014; Buldur, 2017; Elmas, Demirdogen, & Geban, 2011; Finson, Pederson, & Thomas, 2006; Minogue, 2010). It also has the advantage of being used with larger samples. Thus, using the DASTT-C instrument, it is possible to access a larger number of participants, increasing the generalizability of the findings. In the light of the mental model analysis, it can be concluded that teaching self-efficacy plays an important role in in-service science teachers' teaching beliefs regarding student-centered or teacher-centered and their teaching styles, whether explicit, conceptual, or explanatory.

Lastly, determining science teachers' teaching self-efficacy during their in-service period is essential because a well-prepared teaching focus is necessary for effective science education (Weiss, Banilower, McMahon, & Smith, 2001). However, a review of the relevant literature indicated that most of the available research conducted on the sources and consequences of the teacher self-efficacy in a single study with in-service science teachers is relatively less than pre-service science teachers (Kıran, 2018; Kıran, 2021). Therefore, in-service middle school science teachers were considered as a sample to improve desired teacher outcomes and student outcomes in science education. According to the literature review about pre-service teachers' self-efficacy results, mostly suggested that more attention should be given to teacher education programs. Moreover, it is also necessary to examine in-service science teachers' self-efficacy and to define implications of the findings because teachers' professional development starts with pre-service teacher education and continues with the in-service training process.

1.2 Purpose of the Study

The study aims to investigate the relationships between sources and consequences of middle school in-service science teachers' self-efficacy. As sources of teachers' teaching self-efficacy, Bandura's hypothesized four sources of self-efficacy, job

satisfaction, years of teaching experience, and teachers' implicit theory of science ability; and as consequences of teachers' self-efficacy, mental models regarding their teaching beliefs such as teacher-centered or student-centered are considered. Accordingly, the present study aims to determine whether sources of self-efficacy predict teachers' teaching self-efficacy and whether teachers' teaching self-efficacy predicts teachers' mental models regarding their teaching beliefs. In addition to this, it is considered science teachers' teaching self-efficacy is different with respect to their mental models regarding their teaching styles. More specifically, the study addresses the following research questions:

1. How well do the proposed sources of teaching self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self efficacy?

    1.1. How well do the proposed sources of teaching self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self efficacy for classroom management?

    1.2. How well do the proposed sources of teaching self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self efficacy for student engagement?

    1.3. How well do the proposed sources of teaching self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and

physiological states) predict in-service science teachers' teaching self efficacy for instructional strategies?

2. How well do in-service science teachers' teaching self-efficacy for classroom management, student engagement, and instructional strategies predict their mental models regarding their teaching beliefs?

3. Does in-service science teachers' teaching self-efficacy differ with respect to their mental models regarding their teaching styles?

1.3 Definitions of Important Terms

Teacher self-efficacy

Based on Bandura's social cognitive theory, Tschannen-Moran and Woolfolk Hoy (2001) defined teachers' sense of efficacy as a teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (p.783).

Teacher Job satisfaction

Teacher job satisfaction described as teachers' affective attitudes toward their work and their teaching role (Skaalvik & Skaalvik, 2010).

Implicit Theory of Science Ability

Science teachers' beliefs on their students' science ability whether it is malleable or fixed (Yerdelen & Sungur, 2019). Teachers' implicit theories can be incremental or entity for science ability. Teachers with incremental theory believes that their students' science ability can be changed, whereas, teachers with entity theory believes their students' science ability are fixed (Dweck,1999).

Mastery Experience

Teachers' judgements about their self-efficacy based on the perceptions of past teaching experiences (Bandura, 1997).

Vicarious Experience

Teachers obtain self-efficacy information by observing or modeling the success or failure of other teachers' performance (Bandura, 1997).

Verbal Persuasion

Teachers develop their self-efficacy from judgements about their teaching performance from colleagues, school principals or their students (Bandura, 1997).

Physiological and Emotional States

Teachers, experience fear, anxiety, mood, and stress,influence their judgments about their capabilities and also their teaching practices (Bandura, 1997).

Mental Model

Teachers' mental models explanation of their thought process about how their teaching beliefs such as teacher-centered or student-centered works in the real world (Thomas, Pedersen, & Finson, 2001).

CHAPTER 2

LITERATURE REVIEW

This study's main focus involves the examination of the in-service science teachers' teaching self-efficacy beliefs in relation to proposed sources. In addition, the consequence of in-service science teachers' teaching self-efficacy will be examined. In line with these purposes, this section first describes self-efficacy as a construct of the study. The review continues with teachers' teaching self-efficacy. As sources of teaching self-efficacy, Bandura's hypothesized four sources of efficacy, job satisfaction, years of teaching experience, and teachers' implicit theory of science ability are presented. The review ends with teachers' mental models regarding their teaching beliefs as a consequence of teachers' teaching self-efficacy.

2.1 Self-efficacy as a Construct

Over four decades ago, Bandura proposed the social cognitive theory (1986, 1997), which emphasizes human functioning. According to Bandura (1986), human functioning is considerably affected by self-efficacy beliefs. Self-efficacy is defined as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p.3). Self-efficacy influences individuals' behavior and motivation through their choices, goals they set, the effort they put, and persistence (Bandura, 1997; Hoy, 2004; Pajares & Schunk 2001). For example, individuals with high self-efficacy beliefs are more likely to choose challenging tasks, set mastery goals to gain knowledge and skill, put more effort to accomplish these tasks and goals, and persist longer in the complex tasks, which finally improves their performance and achievement. Undoubtedly, individuals are likely to choose and engage in an activity or task on which they hold strong self-efficacy beliefs; otherwise, they tend to avoid it (Bandura, 1997).

Since the self-efficacy belief concept was introduced, research in many areas has revealed the importance of efficacy beliefs in learning, performance, and motivation. Indeed, there are various research on self-efficacy beliefs in the field of psychology, health, nursing, sports performance, diet programs, education, and career choice (Pajares, 1996). In educational research, self-efficacy studies have been across several fields, including mathematics, science, reading, and writing (Britner & Pajares, 2006; Butz & Usher 2015; Joët et al., 2011; Schunk, 2003).

In educational contexts, Lunenburg (2011) emphasized that self-efficacy influences individuals' learning process and performance that "people try to learn and perform only those tasks that they believe they will be able to perform successfully" (p.1). Therefore, self-efficacy is regarded as a significant predictor in both developing teacher quality and students' academic achievement.

There are several characteristics of self-efficacy to be highlighted. Firstly, one of the unique features of self-efficacy is task-and-context specific rather than global constructs (Bandura, 1997). According to Ignat and Clipa (2010), self-efficacy is individuals' judgments about their abilities in a specific situation and emphasize that self-efficacy is "belief about the ability to coordinate skills and abilities in order to reach desirable objectives within particular domains and circumstances" (p.181). For example, it is an essential characteristic of self-efficacy within the educational field because it motivates individuals to believe that if students have difficulty learning or performing a task in mathematics does not mean they will have trouble in chemistry. Therefore, researchers have given a great deal of their attention to examining students' efficacy beliefs across many domains such as mathematics (Toland & Usher, 2016), biology (Baldwin, Ebert-May, & Burns,1999), chemistry (Çapa Aydın & Uzuntiryaki, 2009), and writing (Bruning, Dempsey, Kauffman, McKim, & Zumbrunn, 2013). In the science education field, researchers asserted the domain-specific feature of self-efficacy in their study (e.g., Glynn, Taasoobshirazi

& Brickman, 2009; Capa & Uzuntiryaki, 2009; Pintrich & De Groot, 1990; Sezgintürk & Sungur, 2020; Tuan, Chin & Shieh, 2005; Wang, Liang & Tsai, 2018). Literature results show that domain-specific measurements are better predictors of students' motivation and academic performance than global measurements (Klassen & Usher, 2010).

Secondly, one of the fundamental characteristics is the multidimensionality of self-efficacy belief theory. According to Bandura (1995), due to the domain-specific characteristic of self-efficacy, an acceptable self-efficacy measurement needs a multidimensional assessment method rather than a singular (one-dimensional) scale. For this purpose, some researchers have recently developed multidimensional instruments to measure teachers' science teaching self-efficacy (Emmer, 1990; Gibson and Dembo, 1984; Riggs & Enochs, 1990; Tschannen-Moran & Woolfolk Hoy, 2001). Tschannen-Moran and Woolfolk Hoy (2001) developed the Teachers' Sense of Efficacy Scale (TSES). The instrument conceptualized the teachers' sense of efficacy beliefs in terms of different dimensions, including efficacy for instructional strategies, efficacy for classroom management, and efficacy for student engagement.

Thirdly, self-efficacy beliefs express individuals' perceptions of their capabilities rather than accurate assessments of their actual performances. As Bandura (1997) stated, “Perceived self-efficacy is not a meaning of the skills one has but a belief about what one can do under different conditions with whatever skills one possesses.” (p.37). Indeed, Bandura (1997) suggests a significant difference between having the necessary metacognitive skills and using them effectively. It is a necessary distinction because individuals' choices, effort, and persistence depend more on what they believe about their capabilities than their actual capability (Bandura, 1997). Also, according to Goddard et al. (2004), predicting actual capabilities may affect how well individuals use the skills.

Lastly, as defined in social cognitive theory, all kinds of efficacy belief constructs, student, teacher, and collective, are future-oriented judgments about the capacity to organize and execute the courses of action in specific tasks (Bandura, 1997). As Hoy (2004) exemplified, future-oriented feature "self-efficacy beliefs are about the future, about what I will be able to do in a particular situation, not what I already accomplished or why I accomplished it in the past" (p.3). Self-efficacy works before students are involved in a specific situation or context, consequently affecting their motivation and performance (Capa-Aydin, Uzuntiryaki-Kondakci, & Ceylandag, 2018).

Within the educational context, researchers have demonstrated student academic achievement are positively linked with the students' beliefs about their self-efficacy (Pajares, 1994), teachers' beliefs about their teaching sense of efficacy (Tschannen-Moran & Woolfolk Hoy, 1998), and teachers' judgments about the collective efficacy in schools (Goddard, Hoy, & Woolfolk Hoy, 2000). Of the three kinds of efficacy beliefs, teachers' sense of efficacy, the main focus of this study, has been a discussion topic in terms of meaning and measurement among the researchers (Gibson & Dembo, 1984; Pajares, 1996; Tschannen-Moran & Woolfolk Hoy, 1998). However, increasingly, researchers are concluding that teachers' sense of efficacy beliefs positively influence their beliefs about teaching and instructional behaviors (e.g., Skaalvik & Skaalvik, 2007). It is also perceived that the teachers' teaching self-efficacy is a powerful source of desired teaching practices in terms of classroom management, instructional strategies, and student engagement (Tschannen-Moran & Woolfolk Hoy, 2001).

Moreover, Bandura (2006) reported that teachers' confidence in their teaching affects their judgments about their abilities. More recent studies have investigated teachers' teaching self-efficacy beliefs to teach specific domains such as science, art, and math (Klassen, Tze, Betts, & Gordon, 2011). However, the current study aims to extend

the available studies focusing on the sources and consequence of science teachers' teaching self-efficacy, which can be considered an initial step to improve teaching and learning outcomes.

Bandura (1997) indicated that efficacy beliefs are formed when individuals weigh and select different self-efficacy sources as a result of a cognitive process. Bandura (1997) proposed four self-efficacy sources that contribute to developing self-efficacy: mastery experiences, vicarious experiences, verbal persuasion, and physiological and affective states.

The first and the most salient source is *mastery experience*, which leads to individuals' past performances. Individuals interpret their past experiences as success or failure and judge their capabilities for similar tasks in the future. For example, when individuals consider the previous experiences as a success, their self-efficacy beliefs are more likely to be enhanced; on the other hand, their self-efficacy is lowered when experiences are viewed as a failure (Bandura, 1977).

The second source of information is *vicarious experience*, which is also an influential source if individuals have limited past experiences (Bandura, 1977). The vicarious experience is obtained by observing others' successes and failures. Individuals see others as role models, observe them, and make comparisons that play a role in forming their beliefs about their capabilities (Bandura, 1977). When the model performs well, the observer's self-efficacy beliefs tend to be enhanced; otherwise, it becomes a detrimental effect (Bandura, 1977; Goddard et al., 2004)). Also, if the similarity in age, gender, and experience years between the observer and the model increases, the observer's self-efficacy also improves.

The third source is *verbal persuasion*, which can also help or prevent the development of self-efficacy beliefs. For example, an individual can be affected by verbal feedback by others such as family members, colleagues, and friends to convince them about the capability of accomplishing a task.

Finally, the last source that affects self-efficacy suggested by Bandura (1977) is about individuals' interpretation of their *physiological and affective states* such as anxiety, stress, pain, and mood. For example, if a person is experiencing anxiety about performing a specific task because of doubt in their ability to complete, their self-efficacy will be diminished (Usher & Pajares; 2008).

In the present study, as detailed in the following sections, in addition to the four sources suggested by Bandura, science teachers' implicit beliefs about science ability, job satisfaction, and teaching experience will be examined as potential sources of teacher self-efficacy. In addition, the relation between in-service science teachers' self-efficacy and their mental models regarding their teaching beliefs in terms of student-centered or teacher-centered will be examined. Science teachers' self-efficacy will be investigated from a multidimensional approach.

2.2 Teachers' Sense of Self-Efficacy

Teaching self-efficacy has developed as an essential construct in teacher education over 20 years. Teaching self-efficacy is grounded in social cognitive theory (Bandura, 1977; 1986; 1997). Teachers' sense of efficacy beliefs have been defined as a teacher's "judgment of his or her capabilities to bring about desired outcomes of student engagement and learning, even among those students who may be difficult or unmotivated" (Tschannen-Moran & Woolfolk Hoy, 2001, p.783). Several studies

have demonstrated that teachers' sense of efficacy beliefs have been significantly associated with many student outcomes such as cognitive achievement achievement (Caprara, Barbaranelli, Steca, & Malone, 2006; Guo, Connor, Yang, Roehrig, & Morrison, 2012; Woolfolk-Hoy & Davis, 2009), motivation (Ashton & Webb, 1986; Midgley, Feldlaufer, & Eccles, 1989), students' self-esteem (Borton, 1991), self-efficacy (Anderson, Greene, & Loewen, 1988; Ross, Hogaboam-Gray, & Hannay, 2001), students' engagement (van Uden, Ritzen, & Pieters, 2014) and attitude toward school (Miskel, McDonald, & Bloom, 1983) in several ways.

Furthermore, teachers' teaching self-efficacy have also been related to teacher outcomes such as enthusiasm, persistence, effort, goal orientation, and instructional behavior (Bandura, 1997; Pajares, 1996; Tschannen-Moran & Woolfolk Hoy, 2001; 2007). Teachers who hold a higher level of self-efficacy beliefs are more likely than teachers who hold a lower level of self-efficacy beliefs to exhibit planning and organization (Allinder, 1994), to use appropriate teaching methods (Caprara, Barbaranelli, Steca, & Malone, 2006; Tschannen-Moran & Woolfolk Hoy, 2001) in order to meet students' needs better and to keep them on task. Moreover, teachers with strong efficacy beliefs tend to work longer with students who need special learning (Gibson & Dembo, 1984) and be less critical of their mistakes (Ashton & Webb, 1986). According to Tschannen-Moran and Woolfolk Hoy (2001), teacher efficacy belief is a simple idea with powerful implications. They stated that teachers with strong self-efficacy have a high level of job enthusiasm and commitment, so they are more willing to stay in the teaching profession.

Based on reviewing 88 kinds of researches about teaching self-efficacy, Ross (1994, 1998) revealed six teacher behaviors: learn and apply new teaching approaches and strategies, utilize management strategies encouraging student autonomy, give support to students with low achievement level, form students' perceptions of academic skills, establish achievable goals, and insist on the face of student failure

(as cited in Woolfolk Hoy & Spero, 2005, p.345). In addition, teaching self-efficacy beliefs are powerful predictors of teachers' behaviors to determine how much effort they invest, which goals they set, and how much they persist on when things go wrong (Opperman, Brunner, & Anders, 2019; Tschannen-Moran & Woolfolk Hoy, 2001).

In line with all these studies, it could be inferred that teaching self-efficacy has an impact on desired teacher outcomes as well as desired student outcomes. By focusing on the sources of teacher efficacy, desired teacher outcomes can be reached and, in turn, student outcomes, too. Therefore, all this makes it worthwhile to do a detailed analysis of teachers' self-efficacy, such as investigating the sources of self-efficacy.

Although many researchers have examined the construct of teaching self-efficacy, the definition of the construct and proper measurement methods have become the discussion subject (for an extensive overview, see Tschannen- Moran & Woolfolk Hoy, 2001). In fact, as emphasized in social cognitive theory, self-efficacy characteristics which include being future-oriented, domain-specific, and multidimensional, should be considered before the measurement. According to Bandura (1995), due to the domain-specific characteristics of self-efficacy, an adequate self-efficacy measurement requires a multidimensional analysis method rather than a singular (one-dimensional) scale. Indeed, it is important to note that a teacher may be confident in teaching one domain such as science, math, or art but not in another domain. Further, for instance, while measuring science teaching efficacy, it should be examined through multidimensional perspectives.

For this view, some researchers have developed several reliable multidimensional instruments to measure teachers' teaching self-efficacy, and in some instances, in specific domains (Gibson and Dembo, 1984; Riggs & Enochs, 1990; Emmer, 1990;

Tschannen-Moran & Woolfolk Hoy, 2001). For example, Tschannen-Moran and Woolfolk Hoy (2001) developed the Teachers' Sense of Efficacy Scale (TSES) by considering the teacher efficacy construct features. The researchers identified three teaching efficacy dimensions: efficacy for instructional strategies, efficacy for classroom management, and efficacy for student engagement by using in-service and pre-service teachers' frequent teaching activities. Efficacy for instructional strategies emphasizes teachers' confidence in using various teaching strategies and providing alternative solutions for better instruction. This dimension focuses on the teacher's expectation of instructing students, explaining the subject matter, advising students in their work, and answering questions to promote students' comprehension. Efficacy for classroom management indicates the degree of teachers' ability to manage the classroom environment effectively and manage students' behavioral problems. This dimension shows the confidence to keep discipline and order by getting students with disruptive behavior to follow classroom or school rules. Lastly, efficacy for student engagement shows the level of teachers' confidence in engaging all and motivating students to perform well (Tschannen- Moran & Woolfolk Hoy, 2001).

Much research on teacher efficacy continues to explore and define the factors affecting the development of teaching efficacy. Many researchers examined Bandura’s hypothesised four sources of self-efficacy as a source of teacher self-efficacy. Mastery experiences, vicarious experiences, verbal persuasion, and physiological and emotional states are important sources that contribute to developing teacher self-efficacy (Bandura, 1997; Schunk, 2004; Bruce & Ross, 2008; Capa-Aydin, Uzuntiryaki-Kondakci, & Ceylandag, 2018; Mohamadi & Asadzadeh, 2011). Mastery experience is considered as the most important source to develop teacher self-efficacy (Bandura, 1997; Hoy, 2004; Tschannen-Moran et al., 1998).

Other researchers suggested that teaching experience is another factor that affects teaching efficacy (Klassen & Chiu, 2010; Strosher, 2003; Yerdelen et al., 2016; Williams, 2012). For instance, teachers with more years of experience are more likely to implement new teaching methods, which in turn may improve their self-efficacy in teaching science (Yerdelen et al., 2016). Another example is the nonlinear relationship between teacher efficacy and years of experience; teacher efficacy rises to the middle of the career and then falls (Klassen & Chiu, 2010).

Many researchers also stated that job satisfaction is an alternate factor that influences teachers' self-efficacy. Job satisfaction or dissatisfaction guides teachers' performance, goals, persistence, and efforts in the classroom atmosphere (Caprara et al., 2006; Klassen & Chiu, 2010; Klussman et al., 2008; Kıran & Sungur 2018; Ollube, 2006; Skaalvik & Skaalvik, 2010).

The teachers' implicit theory of science ability is another possible factor that affects teaching self-efficacy. This teacher belief factor has an influence on teachers' behaviors and attitudes during the lesson (Dweck, 1986; Lee, 1996; Lynott & Woolfolk, 1994). Some teachers who think the science ability is a fixed, stable, and non-malleable trait. They may think that there is no control over the student's learning. Also, these teachers fear failure and choose easy tasks that will not make them appear unsuccessful. This may cause the teacher efficacy to be at a low level. Conversely, some teachers who believe that science ability is flexible, malleable, and adaptable can be changed by using different and appropriate strategies. They may think that they can have an impact, that they can improve these outcomes. These teachers are expected to have higher teaching efficacy, seek challenges, and persist in challenging tasks to learn and apply new teaching methods. (Dweck, 1986; Dweck et al., 1995; Hong, Chiu, Dweck, Lin, & Wan, 1999; Plaks, Grant, & Dweck, 2005).

In sum, revealing science teachers' judgments about their capabilities and understanding the factors affecting their judgements can guide while deciding on the actions to be taken to improve science teachers' teaching self-efficacy. The literature on in-service science teacher self-efficacy has some gaps that need to be addressed, such as the insufficient number of studies, and the need for a qualitative approach of investigation (Klassen et al., 2011). The subsequent subsections present the potential sources of science teachers' self-efficacy examined in the present study, and science teachers' mental models regarding their teaching beliefs and teaching styles as a consequence of the self-efficacy.

2.3 Sources of Teachers' Self-Efficacy

In the educational setting, teachers' sense of self-efficacy beliefs has been investigated in terms of its sources and its consequences. In the present research, Bandura's hypothesized sources, job satisfaction, years of teaching experience, and implicit theories of intelligence as sources of in-service science teachers' efficacy beliefs were investigated. In the following sections, each of these sources and the relationship with teaching self-efficacy is displayed.

2.3.1 Bandura's Hypothesized Sources for Teacher Self-efficacy

Teachers' teaching self-efficacy can be defined by using Bandura's hypothesized four sources of information since, as stated before, efficacy beliefs are developed as a result of cognitive processing of different sources of information. Bandura (1986; 1997) proposed four sources of self-efficacy information that may influence the formation of teacher efficacy, which are mastery experiences, vicarious experience, verbal persuasion, and physiological and emotional arousal.

Mastery experience is considered as the most significant source (Bandura, 1997; Hoy, 2004; Tschannen-Moran et al., 1998) since teachers can judge their level of capabilities by evaluating the results of their past experiences (Capa-Aydin, Uzuntiryaki-Kondakci, & Ceylandag; 2018). Teachers evaluate their performance at the end of their teaching and develop efficacy beliefs in their capacity to perform similar performances. They act according to these beliefs they develop in their following teaching (Bandura, 1986). Accordingly, when teachers perceive their past experiences as successful, their self-efficacy beliefs tend to be raised to perform well in a similar task, or too often experienced failures may diminish their self-efficacy.

In addition to their direct experience, teachers can also develop self-efficacy through vicarious experiences by observing, evaluating, comparing, and modeling others, especially when they have lack experience (Bandura, 1997; Schunk, 2004; Mohamadi & Asadzadeh, 2011). However, vicarious experiences are not as influential as the experiences obtained directly in the formation of self-efficacy. According to Bandura (1997), teachers can judge their capabilities as a result of observing other teachers' performances, mainly when they have limited past experiences. If the model teacher performs well, the observer teacher's self-efficacy can enhance or decrease. If the model teacher performs poorly, the observer teacher's self-efficacy can enhance or decrease. The greater the similarity between the model and the observer, the stronger the effect on self-efficacy (Bandura, 1997).

Another source important in shaping self-efficacy is verbal persuasion. Teachers' teaching self-efficacy is influenced by the comments of other people working in their professional field. Verbal feedback, praise, encouragement and criticism from colleagues, family, as well as from students can affect the teachers' self-efficacy and hence can affect their performance effort (Bandura, 1997). This type of efficacy source is the least effective in the long term period, but it can be effective in the short term (Mohamadi & Asadzadeh, 2011). The strength of persuasion depends on the

experience, credibility, and reliability of the person giving the feedback since verbal persuasion provides specific feedback on a teacher's performance, it can give information about teaching, encouragement, and strategies to overcome obstacles. According to Bandura (1997), it is easier to lower self-efficacy through negative evaluations than to increase it with positive encouragement.

Finally, physiological and emotional states such as mood, anxiety, excitement, fear, and tension experienced by teachers about teaching contribute to developing their judgments about their capabilities in that subject, depending on how these arousals are interpreted (Aydın, Uzuntiryaki, Temli, & Tarkın, 2013). Positive mood can strengthen self-efficacy, while negative mood can weaken by hindering performance (Usher & Pajares, 2008). The physiological and emotional arousal level experienced by a successful performance teacher can increase their teaching self-efficacy (Bandura, 1997).

Teaching self-efficacy is an issue that has attracted the attention of researchers in recent years due to its influential role in teaching and learning. Therefore, it is necessary to have information about the factors affecting teachers' teaching self-efficacy in order to strengthen teachers' capability judgments. Based on the relationship between self-efficacy and achievement, supposed by Bandura, if the sources that improve teachers' teaching self-efficacy beliefs are identified, it can be ensured that teaching is more effective by improving teachers' self-efficacy.

Bruce and Ross (2008) examined the effects of peer coaching and teacher efficacy beliefs to have an impact on student learning with 12 elementary mathematics teachers. The teachers participated in a six months development program, which includes teaching strategies and peer coaching. The researchers collected data through classroom observations, teacher self-reports, interviews, and also field notes.

The results showed that teachers implemented effective mathematics teaching strategies to promote student interaction and, the professional development program has a positive impact on in-service teachers' sense of efficacy beliefs. Moreover, Bruce and Ross (2008) found the impact of mastery experiences, verbal persuasions, vicarious experiences, and physiological and affective states on teacher efficacy. According to the researchers, one source strengthens another, and the four sources together enable the application of innovative and challenging teaching techniques.

However, in another study, the same researchers found that Bandura's four self-efficacy sources contribute to teachers' teaching self-efficacy for classroom management. In a randomized field trial, Ross and Bruce (2007) found that teachers who participated in a professional development program that focuses on Bandura's four sources of self-efficacy resulted in a higher level of teaching efficacy only for classroom management, not for student engagement or instructional strategies.

Mohamadi and Asadzadeh (2012) investigated the mediating role of teachers' teaching self-efficacy in the relationship among sources of self-efficacy and students achievement. The data was collected from 284 high school teachers by using the Sources of Teachers Self-efficacy Inventory (Henson, 1999) and the Teachers' Sense of Self-efficacy Test (Tschannen-Moran & Woolfolk Hoy, 2001). The results show that the sources of self-efficacy directly, positively and significantly influences the teachers' self-efficacy beliefs. And also, the sources of self-efficacy information indirectly influences students' achievement through the teachers' self-efficacy beliefs.

Mohamadi, Asadzadeh, Ahadi and Jomehri (2010) conducted a study and one of the purposes of the study was to investigate the relationship between teachers. Self-efficacy sources, teaching self-efficacy and student achievement. The participants

were 284 high school teachers. Data were collected via Academic Sources of Self-efficacy Inventory (Henson, 1999), Teachers' Sense of Self-efficacy Test (Tschannen-Moran & Woolfolk Hoy, 2001) and academic achievement test. The results show that the sources of self-efficacy directly affects teachers' teaching self-efficacy and indirectly affects students' achievement.

Rubble, Usher and McGrew (2011) conducted a preliminary investigation to explore the relationship between the sources of self efficacy and teachers' teaching self efficacy. The data were collected from special education teachers of autism. The researchers include only three of Bandura's hypothesized sources: mastery experience, social persuasion, and physiological and affective states. The results indicated that there is a significant association only between physiological and affective states and teacher self-efficacy.

Although the presente researches confirm the predictive power of teacher self-efficacy on desired teacher outcomes, there are a limited number of study examining sources of teaching self-efficacy (Cansoy, Polatcan & Parlar, 2018; Klassen et al., 2011). Klassen, Tze, Betts, and Gordon (2011), reviewed the literature of teacher efficacy research for the years between 1998 and 2009. In their review research, the researchers suggested that measuring the sources of teachers' efficacy beliefs with reliable and valid instruments is the only way to understand and foster teachers' efficacy beliefs. Cansoy et al. (2018) reviewed 48 studies on teacher self-efficacy in Turkey published between 2000-2017 and they realized that there is only one study on the sources of teacher self-efficacy. Moreover, Usher (2009) asserts that while well designed and extensive researches are conducted on students' self-efficacy, there are no similar works for teacher self-efficacy. Additionally, it can be declared that the studies mostly conducted with pre-service teachers (Cakiroglu, 2008; Uzuntiryaki, 2008; Can, 2015; Kinskey, 2018; Menon, 2020; Palmer, 2006; Clark &

Newberry, 2019; Velthius, Fisser, & Pieters, 2014; Zundans-Fraser & Lancaster, 2012) rather than in-service teachers.

In conclusion, teaching self-efficacy indicates teacher's beliefs about their capability to make real desired instructional outcomes. Identifying effects of self-efficacy and its sources will help researchers to understand and improve teachers' teaching efficacy. Therefore, it is aimed to contribute to the teaching self-efficacy literature by examining the in-service science teachers' sources of self-efficacy and the relationship with teaching self-efficacy sub-dimensions: classroom management, instructional strategies, and student engagement.

2.3.2 Job Satisfaction

Teachers' teaching self-efficacy beliefs, of course, do not function independently of other psychosocial determinants that affect their professional well-being, such as job satisfaction. In the research literature, Weiss (2002) defined job satisfaction as "a positive (or negative) evaluative judgment one makes about one's job or job situation" (p. 175). This definition is actually similar to Locke's (1969) definition in his paper, " What is job satisfaction?" Locke stated that job satisfaction is a pleasurable or positive emotional state resulting from the appraisal of one's job. Under these definitions, Skaalvik and Skaalvik (2010) described teacher job satisfaction as teachers' affective attitudes toward their work or their teaching role. Also, Caprara et al. (2003) regarded job satisfaction as a "decisive element" (p.823) in teachers' attitudes to the school, also for the improvement of their motivation and performance as well.

Many research studies are devoted to teacher job satisfaction related to a wide range of school environment variables. Dinham and Scott (1998) classified these variables into three domains: intrinsic rewards of teaching, factors extrinsic to the school, and school-based factors. The intrinsic rewards of teaching include day-to-day classroom activities, working with the students, and observing their progress. Factors extrinsic to the school concern teachers' negative depiction in the media and a decrease in teaching status. School-based factors include student misbehavior, working conditions, time pressure, and relations with colleagues, administrators, parents.

Teachers spend most of their working hours with children rather than adults (Michaelowa & Wittmann, 2007); therefore, teaching may bring stress with student behaviors and demands from school leadership or parents (Greenglass & Burke, 2003). In addition to this, for example, since the science course requires laboratory applications, it may require more interaction with management, staff, or colleagues in terms of material procurement, use of common spaces (laboratory, science classroom, etc.), use of materials, and preparation of activities. Liu and Ramsay (2008) concluded that stress from inadequate work conditions, limited time for lesson planning or preparation, and heavy teaching workload reduce teaching satisfaction. As a result, the level of teaching satisfaction and motivation may be reduced by a higher level of teaching stress at work (Greenglass & Burke, 2003; Kiran & Sungur, 2018). Also, teachers with more tremendous teaching stress have lower self-efficacy (Skaalvik & Skaalvik, 2007), lower teacher-student harmony, and lower effectiveness (Kokkinos, 2007). Moreover, teachers with low job satisfaction levels probably show lower engagement and are at higher risk of leaving their profession (Evans, 2001; Ingersol 2001). On the other hand, teachers who experience higher satisfaction with their job; they are willing to take extra-roles toward students and school (Somech & Dranch-Zahavy, 2000), prepare effective instruction, and be successful in improving students' educational gains (Demirtaş, 2010). Therefore, it should be expected that teacher job satisfaction is positively correlated with desirable teacher characteristics (Klussmann et al., 2008). Teachers

with higher teaching self-efficacy are more willing to appreciate school components' supplement to the school's functioning, think of the principal, colleagues, staff, students, and parents as behaving under their responsibilities, and view the school as a system capable of following the mission (Caprara et al., 2003). Caprara et al. (2006) stated that it is likely that job satisfaction guides teachers' sense of efficacy and supports their efforts towards pursuing children's optimal academic attainments.

In a study, Demirdag (2015) investigated teachers' beliefs about their job satisfaction conducted with 208 middle school teachers from different fields like mathematics, science, and language in the USA. The teachers were found to feel satisfied with the job; however, they indicated dissatisfaction with salary, promotion, rewards, working conditions, and colleagues. The same results have been reached in a different study with 489 elementary, middle, and high school teachers in Turkey (Turkoglu, Cansoy, & Parlar, 2017). Yerdelen, Sungur, and Klassen (2016) administered domain-specific research on 376 Turkish elementary science teachers to determine their occupational well-being. It was found that as the weekly course hours and class size increase, elementary science teachers feel less job satisfaction (Yerdelen et al., 2016).

Teachers' job satisfaction is highly correlated with teacher motivation. According to Caprara et al. (2006), the most influential source of self-efficacy is mastery experiences, and these are nourished by successful or failed past experiences. Successful behaviors experienced in the past may increase teachers' job satisfaction by offering internal and external rewards. Also, teachers' job satisfaction is associated with Bandura's hypothesized physiological and affective states source. For example, according to Tschannen-Moran et al. (1998), teachers with a lower level of sense of efficacy felt more anxiety, anger, and depressive symptoms than teachers with a high lower level of sense of efficacy. They also tended to be more dissatisfied with their jobs and quit their profession.

In a study with 489 elementary, middle, and high school teachers, Turkoglu et al. (2017) investigated the factors related to teachers' job satisfaction. Results revealed that the relationship between teacher job satisfaction and teacher self-efficacy was positive and significant. In another study, Skaalvik and Skaalvik (2017) examined the associations with teacher efficacy, job satisfaction, and school goal structure with 760 elementary and middle school teachers in Norway. Results indicated that there was a positive relationship between job satisfaction and overall teacher self-efficacy. However, the relation between the intention to leave the teaching profession and self-efficacy was negative.

According to Klusmann, Kunter, Trautwein, Lüdke, and Baumert (2008), teachers with high job satisfaction create more learning-supportive environments for students and try to do their best to motivate them. Also, teachers with a high sense of job satisfaction are more successful in solving classroom problems, managing time, and encouraging students to develop their perspectives (Klusmann et al., 2008).

Indeed, previous research conducted by Caprara et al. (2006) has found that high school teachers' self-efficacy beliefs influenced their satisfaction and student achievement. Data were collected through self-report instruments, with the participation of 2184 teachers. The researchers develop the self-efficacy belief instrument based on existing instruments (i.e., Tschannen-Moran et al., 1998) and Bandura's (1997) proposals. However, their self-efficacy measurement was less specific; in other words, it was not multidimensional as Bandura suggested.

Another study was conducted by Klassen and Chiu (2010) to examine the relationship between job satisfaction and three dimensions of teachers' self-efficacy: instructional strategies, classroom management, and student engagement. The sample was 1430 in-service teachers usually working in elementary and high

schools. The results revealed that there were positive relations between teachers' self-efficacy for instructional strategies and for classroom management and job satisfaction, while there was no association between teachers' teaching self-efficacy for student engagement and job satisfaction.

Compared to teachers with less teaching self-efficacy, self-efficacious teachers are reported to be more willing to appreciate other school components' supplement to the functioning of the school, to think the principal, colleagues, staffs, students, and parents as behaving under their own responsibilities, and to view the school as a system capable of following the school mission (Caprara et al., 2003). Caprara et al. (2006) stated that it is likely that job satisfaction guides teachers' sense of efficacy and supports their efforts towards pursuing children's optimal academic attainments.

In sum, research on teacher job satisfaction and dissatisfaction showed that science teachers' occupational well being is a significant predictor of their performance in the classroom environment (Ollube, 2006), their self-efficacy (Caprara et al., 2006; Klassen & Chiu, 2010; Klussman et al., 2008; Kıran &Sungur 2018; Skaalvik & Skaalvik, 2010), and student achievement (Dinham, 1995). Therefore, it is essential to examine teachers' attitudes about their profession regarding expected teacher characteristics. When the literature was reviewed, it was found that relevant studies focusing on the relationship between teachers' job satisfaction levels and their self-efficacy from multidimensional perspective were relatively less. However, Bandura (1997) and Tschannen-Moran and Woolfolk Hoy (2001) suggested that self-efficacy needs domain-specific and multidimensional measures because more specific judgments provide more information about self-efficacy and its sources affecting it. Therefore, this study was focused on the relationship between in-service elementary science teachers' job satisfaction levels and their sense of efficacy beliefs for classroom management, instructional strategies, and student engagement.

2.3.3 Years of Teaching Experience

The relationship between in-service science teachers' efficacy beliefs and their years of teaching experience is one of the particular interests of the present study. Bandura (1997) defined experience as the key sources of teachers' self-efficacy beliefs because once teachers set self-efficacy beliefs, they may resist change (Tschannen-Moran & Woolfolk Hoy, 2001). However, researchers have stated that "little evidence exists about how (teachers') efficacy beliefs change or solidify across stages of a career" (Tschannen-Moran et al., 1998, p. 238).

According to Campbell (1996), the years of teaching experience are significantly related to teacher efficacy development. When the studies investigating the development and levels of teachers' self-efficacy were examined, it was determined that there were differences between pre-service and in-service teachers.Therefore, further research is necessary to clarify the relationship between teacher efficacy and years of experience. For example, while some researchers proposed that there are no differences between preservice and experienced teachers efficacy beliefs (Guskey & Passaro, 1994; Imants & De Brabander, 1996), others proposed that teachers' level of efficacy belief is highest during the preservice years (Brousseau, Book, & Byers, l988; Cannon, 1992; Hoy & Wool-folk, 1990). Teachers' teaching efficacy increases with years of experience (Campbell, 1996; Dembo & Gibson, 1985; Hoy & Wool-folk, 1993; Rubeck & Enochs, 1991). It is also found that teaching efficacy was raised during the preservice years, dropped in the first years of practice, and then expanded as they gained experience (Soodak & Podell, 1997).

Fives, Hamman, and Olivarez (2006) found an association between stressful teaching experiences and teachers' teaching self-efficacy. Further, Gu and Day (2007) reported that teachers faced professional and personal stresses, anxieties, and challenges to their beliefs and teaching; however, during the professional experience,

they overcame job stress and sustained positive emotions. According to Yerdelen, Sungur, and Klassen (2016), higher teaching experience has been associated with a higher level of job satisfaction. It is not an unexpected result; when teachers become more experienced, their knowledge and skills about classroom management, instructional strategies, and student engagement increase concurrently. Teachers also gain experience in dealing with obstacles such as lack of materials, low motivated students, and difficult science topics, which may lead to thinking they can be more effective in teaching (Yerdelen et al., 2016) and, in turn, holding more teaching efficacy.

According to Wolters and Daugherty (2007), teachers with more years of experience were more efficacious to teaching the curriculum in terms of teacher improvement. However, while teaching science, teachers are expected to follow the science curriculum and to use open-ended inquiry-based models because of the rise of the inquiry-based teaching model in science education reform. The same situation is valid in the reforms such as STEM education, flipped classroom teaching model, differentiated instruction model, and project-based learning. However, these kinds of reforms indeed require certain teaching behaviors and skills rather than traditional teaching methods. The introduction of these new teaching models may cause a decrease in teachers' efficacy level for teaching science (Looney, 2003). This reduction is because teachers may not know how to use or may believe that it takes time and money, and so they do not make an effort to implement these models. Facing such challenges early in their career may cause inexperienced teachers to experience job burnout syndrome. However, as the years of experience increase, teachers may find ways to deal with such problems and use appropriate methods. Consistent with this idea, Looney (2003) points out that teaching efficacy for instructional strategies and classroom management was positively associated with teaching experience.

In addition, the literature on teacher efficacy for student engagement in terms of behavioral, emotional/psychological, and cognitive has highlighted the importance of teaching experience. For example, teachers with fewer years of experience would be more affected by their perceptions of student engagement because they may have concerns about classroom management (Fuller, 1969) or lack teaching strategies to keep students engaged and fear using such kinds of strategies (Schaffer, Stringfield, & Wolfe, 1992). Ross (1998) reviewed the efficacy literature and found that teachers with higher self-efficacy levels are more willing to try new instructional methods with students; hence, it is seen that the teachers' efficacy for student engagement beliefs determines the teachers' approach to instruction. Applying student-centered instructional methods helps student engagement, in order to achieve this goal, teachers need to prefer to share classroom management with students. Therefore, teachers should sometimes encourage themselves through their self-efficacy to take risks without fear of making mistakes. Teachers with more years of experience who hold high-level teaching efficacy tend to use high-risk instructional methods such as group works, cooperative learning strategies, and minds on activity-based approaches (Ross, Cousins, & Gadalla, 1996).

A study conducted by Cheung (2007) examined general teacher efficacy levels of in-service primary teachers in Hong Kong by using the 12-item Teachers' Sense of Efficacy scale. Participants were the number of 725 in-service teachers who came from 28 different schools. The results showed that female in-service teachers were significantly higher teaching self*efficacy than male in-service teachers. Moreover, it is also found that years of teaching experience have a weak but significant relationship to general teacher efficacy levels. Cheung (2007) interpret the results as years of teaching experience may help solve the problem of male inservice teachers' low efficacy levels.

Another study conducted by Wolters and Daugherty (2007) examined the impact of teaching experience on teacher efficacy and goal structures with a large number of 1024 teachers from the United States. The sample was classified into four groups: 0-1 year, 1–5 years, 6 –10 years, and 11+ years of experience. Later, the Teachers' Self-Efficacy Scale (Tschannen- Moran and Woolfolk Hoy, 2001) was applied to the participants. The researchers found that years of teaching experience have moderate effects on teaching self-efficacy for instructional strategies and classroom management, but there is no relation between experience and teaching self-efficacy for student engagement. However, teachers with 10 years or more of experience were studied in only one group, which can be a limitation for this study because the relationship between teaching self-efficacy and years of experience may not be linear.

Klassen and Chiu (2010) conducted research, and one of the aims was to investigate the relationships among teachers' years of experience and three dimensions of self-efficacy (instructional strategies, classroom management, and student engagement) with a large sample of 1,430 in-service teachers from Canada. The data were collected from a variety of teaching grades from kindergarten to high school. The participants have a mean of 13.21 years teaching experience. The results showed that there is a nonlinear relationship between teachers' years of experience and all three self-efficacy dimensions, rising from the beginning of the career to mid-career and decreasing afterward.

In conclusion, according to Williams (2012), background factors like years of teaching experience could impact the teachers' beliefs and their behaviors, motivation, and emotional outcomes. Many studies have been conducted on the relationship between teachers' self-efficacy and teaching experience based on the literature with inconsistent results. Also, although much research applied multidimensional methods, most of them did not highlight the domain specific

characteristics of teacher efficacy. There is little research conducted with the specific branch teachers, such as only math teachers or art teachers. Therefore, the current study aimed to examine the teaching experience as a teaching self-efficacy source with in-service science teachers.

2.3.4 Implicit Theories of Intelligence

Dweck and Leggett (1998) tried to understand why some individuals with similar abilities in the same situation pursue the adequacy of their ability, whereas others pursue improving their ability. This problem led them to work on the conceptualization of implicit theories of intelligence. According to Dweck (1999), implicit theories involve domain-specific approaches such as intelligence, ability, personality and moral character. Implicit theories of intelligence means that individuals' implicit beliefs about intellectual ability in general (Chen & Pajares, 2010). Dweck (2002) has also stated that "although there are meaningful differences between the terms 'intelligence' and ability, I will use them more or less interchangeably here because the phenomena I am examining most typically apply to both" (p.58). Actually, rather than defining intelligence, Dr. Dweck attempts to research what beliefs individuals have about their intelligence and how these beliefs affect their behavior. Moreover, there are some researchers who adapted implicit theories for use in science classes by asking about an individual's 'science ability' rather than their intelligence in order not to evoke different thoughts in their minds (Chen & Pajares, 2010, 2017; Yerdelen, 2013). Along with the literature, implicit theories of ability are conceptualized in the science education context in the present study. Specifically, the teachers' implicit beliefs of science ability and its relationship with teacher self-efficacy will be investigated.

Dweck (1999) determined two forms of beliefs about human attributes for understanding ability, and she introduced each form as a basic theory. Some

individuals hold an entity theory of ability, called entity theorist, to believe that intelligence is a fixed, stable, and non malleable trait. Conversely, other individuals hold an incremental theory of ability, called incremental theorists, to believe that ability is a flexible, malleable, and adaptable trait through effort (Dweck, 1999; Dweck & Leggnett, 1998). More specifically, these implicit intelligence theories have many repercussions for both students and teachers in the educational context. However, as stated before, in this study, mainly teachers' implicit beliefs will be considered. Some students with an entity view of ability are more willing to believe that abilities are traits that a person has to various degrees (Chen & Pajares, 2010). Also, Entity students believe that they should look smart and not look stupid. Easy tasks, achievement with low effort, and performing better than other students make students with the entity theory feel smart (Dweck, 2000). In contrast, students with an incremental view of ability tend to believe that abilities are increasable and changeable traits (Chen & Pajares, 2010). Incremental students believe that easy tasks and worrying about looking smart or stupid waste their time. Being fully engaged in new tasks, making an effort to master something, and developing skills make students' incremental theory feel smart (Dweck, 2000). Some researchers stated that teachers' implicit beliefs of ability theories for both about themselves and their students, either entity or incremental, affect their behaviors and attitudes toward students, the classrooms' goal structure, and learning environment (Deemer, 2004; Lee, 1996; Lynott & Woolfolk, 1994).

Individuals who hold different beliefs about themselves think, feel, and behave differently (Dweck, 1999). Dweck, Chiu, and Hong (1995) stated that implicit theories are fundamental assumptions that are not rigidly determining behaviors. Actually, according to social cognitive theory, individuals’ beliefs determine their behaviors and attributes (Bandura, 1986). Consequently, Dweck et al. (1995) regarded the implicit theories as a framework to examine how individuals generate beliefs about themselves (i.e., self-theories) and develop their thoughts, feelings, and behaviors. Consistent with the idea that Dweck and her colleagues present a model

specifying how individuals' implicit theories lead them toward particular goals and how these goals establish different motivational patterns. In this model, as shown in individuals who believe that intelligence is non-malleable (entity theorists) tend to follow performance goals that either gain affirmative judgments of their capability. As a result, they promote maladaptive motivational patterns, which create helpless responses to difficulty, such as avoiding risks or low persistence. On the contrary, individuals who believe that intelligence is a malleable trait (incremental theorists) tend to follow mastery-oriented goals, which create adaptive motivational patterns such as seeking a challenge and high persistence.

Table 2.1 Teachers' Theories, Goals, and Behavior Patterns

Theory of Intelligence	Goal Orientation	Perceived Student Abilities	Behavior Pattern
Entity Teachers	Goal of teaching is to increase student performance.	Low Intermediate High	Maladaptive pattern (depending on their expectation)
Incremental Teachers	Goal of teaching is to increase student learning.	Low Intermediate High	Adaptive pattern (depending on students' expectation)

Note. Adapted from " A study of Teacher Responses Based on Their Conceptions of Intelligence" by Kyunghee Lee, 1996, Journal of Classroom Interaction, 31(2), p.12.

In the educational context, in terms of students, Dweck and Leggnett (1988) found that entity students follow performance goals and maladaptive motivational pattern response ("Easy and fun like the tasks I did before, no need to worry about mistakes so that I can feel smart") versus incremental students follow learning goals and

adaptive motivational response ("It is hard, new, and different, so I can effort to learn from them"). Moreover**,** as summarized in the Table 2.1**,** studies on teachers show that the same ability theories may also influence specific teaching practices in the classroom environment (Dweck & Bempetchat, 1998; Lee, 1996). Entity teachers who view ability as a fixed trait that a student holds tend to perceive students' abilities as low, intermediate, or high (Dweck & Bempechat, 1998). Entity teachers' goal orientation for teaching is to judge students' preliminary performance (Lee, 1996), and they cannot change these judgments easily (Stipek, 2002). To improve students' performance, entity teachers follow maladaptive patterns and apply different treatments depending on their perceived student ability levels (Dweck & Bempechat, 1998). For example, entity teachers assign easy tasks to students who are perceived 'low', protect them from errors or praise them for not remarkable performances because they believe that students cannot overcome failures (Dweck & Bempechat, 1998; Lee, 1996). On the other hand, incremental teachers consider students' ability a malleable trait that can be improved via sustained efforts. Compared with entity teachers, incremental teachers would be willing to promote learning-goals rather than performance goals. Hence, according to incremental teachers, mastery of the content and abilities is more important than the performance (Lee, 1996; Dweck & Bempetchat, 1998). For example, in such classrooms, all students are encouraged to view challenges as chances for development and to value and like the learning process with fair treatment (Dweck & Bempetchat, 1998; Lee, 1996).

According to Dweck's implicit theories model, either entity theory or incremental theory can impact teachers' behaviors and attitudes in essential ways in the classroom. Besides, this model is also useful as a motivational framework. Therefore the current research focused on the implicit theories model in order to examine the relationship between teachers' self-efficacy beliefs and implicit theories. Previously, available research about implicit theories and how it can be implemented to teachers was discussed. Further, literature research on the link between implicit theories and

self-efficacy and the implications that this link has for teaching contexts will be discussed.

The research on implicit theories and self-efficacy has provided a connection between these constructs which is related to teaching contexts. For example, many research has determined that individuals with an incremental theory have high self-efficacy levels and seek challenging tasks, whereas individuals with an entity theory have low self-efficacy levels and choose easy tasks (Dweck, 1986; Dweck et al., 1995; Hong et al., 1999; Plaks et a.l, 2005).

Another study conducted by Bandura and Wood (1989) created a model which described a relationship between individuals' implicit theories of ability and self-efficacy. The researchers studied with graduate students who have similar self-efficacy levels. The students were assigned to an incremental theory group or an entity theory group. This study showed that some students who belong to the entity theory group experienced a decrease in self-efficacy levels according to qualitative and qualitative data. Others who belong to the incremental theory group experienced an increase in self-efficacy levels. This research provided findings that individuals' implicit theories of ability might affect their self-efficacy beliefs.

McWilliams (2012) examined the relationship between teachers' efficacy beliefs and implicit theories toward teaching by using Bandura and Wood's (1989) model. McWilliams found that teachers' inclination to incremental theory was correlated with a high level of self-efficacy; however, the overall correlation between implicit theory and self-efficacy was not significant. These findings are significant because they do not support Bandura and Wood's model (1989), in which teachers' efficacy levels should enhance when their implicit beliefs become more incremental. The

correlation between teachers' self-efficacy and implicit intelligence theories is not as precise as it was hypothesized.

The research on the implicit theory of intelligence in the teaching context is mainly domain-specific. For example, Palazzolo (2016) conducted a mixed study to compare pre-service science teachers' implicit theories and their self-efficacy in teaching science. The researcher collected data from 56 elementary pre-service science teachers at the University of Windsor. An important result demonstrated a significant positive relationship between high self-efficacy in science and incremental view of science ability, which partially supports Bandura and Wood's (1989) suggested model.

Moreover, when teachers hold high self-efficacy levels, this should affect the classroom climate. In particular, for example, Sarrazin, Leroy, Bressoux, and Trouilloud (2007) conduct a study to identify factors leading teachers (N=336) to create such a climate in the classroom. The authors examined whether the respective roles of teachers' implicit theories have a direct influence or are mediated by teachers' self-efficacy. Their finding shows that teachers who regard students' ability as a stable trait set less autonomy-supportive climate goals. In contrast, the teachers' belief that students' ability can be developed with effort results in an autonomy-supportive climate via acting positively on the teachers' efficacy beliefs.

The association between implicit theory types and efficacy can be extended for teaching context in terms of student engagement, instructional strategies, and classroom management. According to Dweck (2000), when teachers with low efficacy tend to hold entity theory patterns, it is expected that they are most likely to

suffer from teaching burnout. As a result, the teacher-student relationship would be affected negatively. Considering that teachers with high efficacy tend to hold incremental theory patterns, they are expected to persist in problem-solving efforts with students (Tamir, John, Srivastava & Gross, 2007). As an example for classroom applications, incremental teachers with high efficacy for student engagement tend to encourage student participation and efforts, praising students for their progress and appraising them through multiple approaches. In contrast, entity teachers tend to focus solely on test results (Tamir et. al., 2007). For example, a study published by Strosher (2003) utilized Dweck's implicit theory model to examine the relationship between implicit theories of intelligence and teacher efficacy beliefs. The study included 142 participants: 71 in-service teachers and 71 preservice teachers. It found that teachers who believe intelligence is a flexible trait had higher teacher efficacy levels for student engagement. Also, results revealed that preservice teachers have higher efficacy beliefs than in-service teachers; however, as preservice teachers gain teaching experience, their efficacy for student engagement decreases.

Similarly, past research that directly focused on teachers' beliefs about their students showed that teachers' instructional strategies are affected by their implicit theories about students' ability (Deemer, 2004; Dweck & Leggnett, 1998; Lee, 1996). For example, in a study with 99 science teachers and 1680 high school students, Deemer (2004) revealed that teachers' beliefs about teaching and learning implicit theories impact their use of instructional practices that focus on mastery classroom goal orientation. To give an example, Lee (1996) with 200 elementary teachers examined how teachers' implicit theories about their students' ability influence their instructional strategies by asking them to estimate their expectations of students' performance on a target task and then the researcher measured their behavior in terms of types of feedback, follow-up assignments, and placement recommendations. Results revealed that entity teachers tend to give non-average scores, ability-oriented feedback, and performance-oriented assignments, and ability-homogenous groups placement choice, while incremental teachers are more willing to give average

scores, effort-oriented feedback, and learning-oriented assignments, and ability-heterogeneous groups placement choice (Lee, 1996). Moreover, Dweck and Leggnett (1998) stated that entity teachers consider measurement tools like tests as ways to assess students' ability and to judge their competence, whereas incremental teachers regard them as opportunities to enhance students' competence, skills, and abilities.

Teachers' efficacy beliefs for classroom management can be related most closely to teachers' implicit theories about student ability because both of them regard students' ability to behave properly in the classroom. For example, high-level teaching self-efficacy for classroom management could predict different outcomes like time spent helping students, controlling disruptive behavior, establishing classroom rules, and getting students to follow these rules. In contrast, lower level teacher efficacy can result in tendencies to give up on students (Bandura, 1993; Tschannen- Moran & Woolfolk Hoy, 2001). To give an example, Williams (2012) aimed to examine to what extent teachers' efficacy for classroom management covaries with their implicit beliefs with 183 high school teachers. Results revealed that as teachers' implicit beliefs about students' ability became more incremental, their efficacy for managing students' classroom behavior became higher.

In conclusion, the studies discussed in the review, many empirical works support that teachers' implicit theories and efficacy beliefs would describe their motivational frameworks, including their teaching performance in the classroom. However, some studies mentioned above did not confidently define a relationship between self-efficacy and implicit theories in teachers. As the results were discrepant, studies must continue about the notion. Also, it seems that the relationship between teachers' implicit beliefs about themselves or students and teaching self-efficacy for student engagement, instructional strategies, and classroom management impacts students' behaviors and, in turn, their academic achievement. Beyond the current findings,

however, there is no comparable research demonstrating evidence to support a relationship between implicit theories and self-efficacy in elementary in-service teachers for teaching science. Maybe it is necessary to consider creating domain-specific analyses to answer whether the relationship is generalizable or vice versa. Consequently, the current study aims to examine the tenets of the implicit theories framework for science teaching self-efficacy along with student engagement, instructional strategies, and classroom management.

2.4 Consequence of Teachers' Self-Efficacy

In the educational context, teachers' teaching self-efficacy has been investigated in terms of its sources and its consequence. In the present research, as a consequence of in-service science teachers' teaching self-efficacy, their mental model regarding their teaching beliefs, whether student-centered or teacher-centered, will be determined using mental models. The following section presents review about teachers' mental models regarding their teaching beliefs and their relationship with teachers' teaching self-efficacy.

2.4.1 Teachers' Mental Models

One of the main aims of this study was to examine in-service science teachers' mental teaching models regarding their teaching beliefs such as teacher-centered or student-centered as a consequence of science teachers' teaching self-efficacy. Additionally, it was investigated whether science teachers' teaching self-efficacy is different with respect to their mental models regarding their teaching styles such as exploratory, conceptual, and explicit were analyzed. In many studies, mental models (or visual data) were described as a representation of perceptions in one's mind. Individuals' perceptions about particular things, such as science teaching, can strongly affect whether they are willing to engage in it or not. (Finson & Pederson, 2011). As a

teacher, we use our perceptions to direct ourselves toward engaging in science teaching. Therefore, visual data about science teaching perceptions in teachers' minds was used as a tool for this study.

Every moment the visual sensory system works, like when we look around, visual information comes from our eyes to our brains. It is important to note that, however, it is not visual data. For something to be called visual data, someone must record, examine, and manage the visual information and obtain some logical meaning (Finson & Pederson, 2011). Moreover, visual data may differ from person to person. For example, two people may see different things even if they are looking at the same thing. One of the reasons for this may be the brain's processing time of visual information (Finson & Pederson, 2011). Another reason may be that people filter past experiences (Goodman, 1988) and culture (Gardner, 1980) while processing visual information (Finson & Pederson, 2011). In the educational context, teachers record their visual data as episodic memories, which influence and frame how they learn and how they teach what they learn. Therefore, teachers' episodic memories can serve as windows opened to their internal beliefs about teaching beliefs.

Using mental images as a tool is not a new concept in science education research. For example, the Draw a Scientist Test (DAST) (Chambers, 1983) has been used to determine students' perceptions about scientists. Finson, Beaver, and Crammond (1995) developed the Draw-A-Scientist-Test Checklist (DAST-C) based on DAST. As an extension version, The Draw- A-Science-Teacher-Teaching Test, or DASTT-C, was developed by Thomas, Pedersen, and Finson (2001) to examine teachers' mental models, has been used. The researchers' intent of this instrument was to help create deeper understandings of teachers' perceptions about science teaching through drawings of their mental models. Thomas and Pedersen (2003) also stated that DASTT-C "could be a useful tool to help teachers recollect memorable episodes within their own ideas, beliefs, and personal theories about how to teach elementary

science, consider alternative theories, and work toward a preferred image of themselves as elementary science teachers " (p. 328).

Moreover, the DASTT-C instrument can also be used to review teacher education program courses. Minogue (2010) conducted a study to determine preservice teachers' beliefs about science teaching and the effectiveness of science method courses by using the DASST-C instrument. The data collected from 50 preservice teachers before and after the science teaching method course. The study showed that after taking the course, the teachers' mental models shift from teacher-centered teaching beliefs to student-centered teaching beliefs. According to results, researchers discussed science teacher education program effectiveness and recommended implications.

Specifically, the instrument has three sections (Thomas et al., 2001). In the first section, the teacher fills the demographic information like pre-service or in-service status. In the second section, the teacher draws a picture as a science teacher according to the prompt of "What is the teacher doing? What are the students doing?". This section enables the elementary science teachers to reflect on their mental models and beliefs about teaching (Finson, Pedersen & Thomas, 2006). In the third section, the DASTT-C instrument involves narrative data where the teacher expresses drawing by writing about it. This section assists the researcher while examining and scoring the drawings; therefore, the researcher can confirm understanding from it without a doubt (Finson et al., 2006). After data was collected from the teachers, the researcher scores the drawings by using the checklist form of the instrument. According to scores gathered from the drawings, the researcher classifies teachers' mental models regarding their teaching beliefs as student-centered or teacher-centered. Also, The researcher decides on teachers' teaching styles such as explicit, conceptual, exploratory with respect to their mental models. After that, the researcher checks the narrative data section to be sure about the

decision. It is important to note that either DASTT-C developers or the researcher are not interested in "good" or "bad" teaching practices (Thomas et al., 2001). It is just about understanding the science teachers' self-perceptions about teaching.

The developers (Thomas et al., 2001) of DASTT-C have defined the terms explicit, conceptual, and exploratory teaching styles in their use as follows: *The explicit teaching style* is a teacher-centered teaching method (Thomas et al., 2001). Explicit instruction is a way to develop particular skills or transfer information to students in which the teacher gives direct, guided, and structured instruction (Whyte & Ellis, 2003). For example, the teacher practices the 'I do, we do, you do' strategy in this classroom. In the 'I do' phase, the teacher demonstrates models and gives students what to do and how to do it without allowing them to form this information by themselves. Students are listening, watching, and taking notes (Whyte & Ellis, 2003). In the 'we do' phase of the lesson, the teacher and students work together on some examples, and the teacher provides corrective feedback (Whyte & Ellis, 2003). The teacher expects students to retrieve and repeat the information learned during the' I do phase' (Billings, 2001). In the 'you do' phase, students practice individually, and the teacher monitors their efforts and meets their needs. In general, when the teacher practices the explicit teaching method, the teacher uses the chalkboard, students study using a notebook and pencils (Whyte & Ellis, 2003). *The conceptual teaching style* is practiced by teachers who utilize the constructivist learning approach (Thomas et al., 2001). Conceptual teaching is a student-centered teaching method, but the teacher leads the lesson by providing information to concept development (Thomas et al., 2001). For example, in this teaching method, the teacher gives tasks regarding inquiry-based activity or experiment. Students conduct activities in small groups to interact with each other while engaging in exploring the materials. Also, the teacher observes them closely (Whyte & Ellis, 2003). *Exploratory teaching style* is a student-centered instruction method (Thomas et al., 2001). There is more student involvement than the teacher. In such a classroom environment, the teacher gives special attention to their students' interests and choices. The exploratory teaching

model can be considered as an open-ended process (Whyte & Ellis, 2003). For example, the questions asked by the students may shape the course of the lesson. The teacher encourages students to investigate new materials or concepts individually or in group work. The teacher helps to improve students' problem solving, innovation skills, and thinking skills rather than memorizing the information (Tatar, Yildiz Feyzioglu, Buldur & Akpinar, 2012). Moreover, in this type of teaching model, besides the classroom practices, out-of-school activities are also frequently performed (Tatar et al., 2012). Thus, thanks to the Draw- A-Science-Teacher-Teaching Test, drawings are utilized to determine which one of the three teaching models in-service teachers practices in the classroom. For example, a study was conducted by Tatar et al. (2012) to explore pre-service science teachers' mental models of science teaching using the DASTT-C instrument. A total of 300 (189 females, 111 males) pre-service science teachers participated in the study. According to the results, most participants (61%) were found to practice conceptual science teaching model, whereas 22% practices exploratory science teaching model and 17% practices explicit science teachers' mental model.

According to Thomas et al. (2001) there is a high relationship between teachers' beliefs on science teaching and their mental models, which indicates their behavior. Also, Norman (1983) suggested that mental models explain the belief system that individual gains by instruction, observation, or inference. By using mental models the association between an individual's mental model and the daily life routine can be examined and also individual's behaviors can be predicted (Norman, 1983). Therefore, using mental model drawings, the instrument in the research would give clues to the teachers' belief systems about science teaching and so classroom practices. For example, the explicit teaching model may be represented by teacher-centered drawings where the teacher is at the center, and students are sitting passively in rows in their desks. The conceptual teaching model may be represented by drawings where the students are at the center of the lesson, but still, the teacher organizes particular tasks such as an experiment. The exploratory teaching model

can be represented by student-centered drawings, in which while students are actively engaging with the materials in groups, the teacher only guides or helps them.

As stated above, the instrument grounded within the mental model framework provides clues to the teachers' belief systems. Therefore, by using this instrument, other concepts including self-efficacy, attitudes, or science identity can be studied (Thomas et al., 2001). For example, by using the DASTT-C instrument, several studies have been conducted to reveal science teachers' perceptions, teaching styles, and classroom environment in the light of mental model framework and self-efficacy instruments (Finson et al., 2006; Thomas et al., 2001; Tatar et al., 2012). Finson, Riggs, and Jesunathadas (2000) stated that teachers' self-efficacy beliefs partially determine how they view themselves and their roles in the science teaching context. When the teacher has a high level of science teaching self-efficacy, their instruction is more likely to be more student-centered by using inquiry-oriented methods (Finson et al., 2000; Finson et al., 2006; Rubeck & Enochs, 1990). Conversely, a teacher who holds a low-level teaching self-efficacy tends to utilize more teacher-centered roles with expository-oriented methods (Finson et al., 2000; Finson et al., 2006; Rubeck & Enochs, 1990).

A study in Turkey conducted by Feyzioğlu, Feyzioğlu, and Küçükçıngı (2014) examined whether there is a relation between the science teachers' mental models and teaching self-efficacy. The subjects were 262 pre-service science teachers. The researchers collected data by using the DASTT-C and Science Teaching Efficacy Belief Instrument (STEBI-B) scales. The STEBI-B, was developed by Riggs and Enochs (1990) to examine science teachers' self-efficacy beliefs, consists of two dimensions, which are "Personal Science Teaching Efficacy" (PSTE) and "Science Teaching Outcome Expectancy" (STOE). Depending on mental models, the results showed that the pre-service teachers' science teaching self-efficacy increases with

the shift from teacher-centered to student-centered education by considering both the PSTE and STOE.

Another research was conducted with 135 pre-service science teachers using DASTT-C and STEBI-B instruments by Finson et al. (2000). The researchers reported that science teachers who hold low teaching self-efficacy did not picture group works. They illustrated themselves as the central figure, whereas science teachers who are self-efficacious were more likely to draw teacher-student interactions through an experiment or activity.

In conclusion, the aforementioned literature provides studies examining preservice teachers' mental models using the DASTT-C instrument and the relationship between science teachers' teaching self-efficacy and their mental teaching models. However, there are relatively limited studies about in-service science teachers. This study focused on the relation between in-service science teachers' teaching self-efficacy from multidimensional approach and their mental models about science teaching. It is expected that this study's results would allow a better understanding of what is known and what is not known about in-service science teachers' perceptions about their teaching through drawings and descriptive writings and its relation with their teaching self-efficacy.

2.5 Summary

In this chapter, research studies related to this study's variables were reviewed. There are findings that as teacher self-efficacy sources, besides Bandura's hypothesized sources, other factors such as years of teaching experience, job satisfaction, and implicit theory of science ability can affect teachers' teaching self-efficacy .

Moreover, according to the literature review, most research focused on these factors with inservice teachers is relatively less than preservice teachers (Kıran, 2021). Therefore, in the present study, the purpose was to explore the teachers' self-efficacy with a sample of inservice science teachers under three dimensions, including efficacy for instructional strategies, efficacy for classroom management, and efficacy for student engagement by using the TSES (Tschannen- Moran & Woolfolk Hoy, 2001) instrument, and then to explore the relationships between sources and consequences of middle school in-service science teachers' self-efficacy. Accordingly, the present study aims to determine whether sources of self-efficacy predict teachers' teaching self-efficacy and whether teachers' sense of self-efficacy predicts teachers' mental models regarding their teaching beliefs. Bandura's hypothesized sources of teaching efficacy (Cantrell, Young & Alan Moore; 2003; Bandura, 1997; Hoy, 2004; Tschannen-Moran et al., 1998), years of teaching experience (Strosher, 2003; Yerdelen et al., 2016; Williams, 2012), job satisfaction (Klassen and Chiu, 2010; Kıran & Sungur 2018; Skaalvik & Skaalvik, 2010), and implicit theory of science ability (Dweck 2000; Strosher, 2003; Williams, 2012), will be explored as sources of science teachers' sense of self-efficacy. These factors are chosen based on Bandura's four sources of self-efficacy, and each factor will be measured all at once for each teacher's sense of self-efficacy subdimensions. After that, as consequences of teachers' teaching self-efficacy, mental models regarding their teaching beliefs will be explored using the DASTT-C instrument. The higher the scores obtained from the instrument indicates the more teacher centered practices. In addition to this, in the present study, science teachers' teaching self-efficacy is aimed to be examined with respect to their mental models regarding their teaching styles.

CHAPTER 3

METHOD

In this chapter, the methodology of the study will be explained briefly. Specifically, the design of the study, population and sample, instruments of the study, the data collection procedures, data analyses, assumptions and limitations of the study, the internal and external validity of the study will be addressed, in order.

3.1 Design of the Study

Using a cross-sectional correlational design, the current study examined sources and consequences of in-service science teachers' teaching self-efficacy. As sources of teaching self-efficacy, Bandura's hypothesized sources, years of experience, job satisfaction, and implicit theory of science ability; and as the consequence of teaching self-efficacy teachers' mental models regarding their teaching beliefs were investigated.

3.2 Population and Sample

The target population of the study was all middle school in-service science teachers in Ankara, while the accessible population was all middle school in-service science teachers in Gölbaşı and Çankaya districts in Ankara. Since it was impossible to reach the accessible population, the sample was selected from the population using a convenient sampling method. During sample selection, ease of transportation, money and time restrictions were considered.

A total of 192 in-service science teachers, 154 female and 38 male, contributed to the present study. The mean age ranges from 23 to 65 (M = 39.08, SD = 9.34). Their years of teaching experience ranges from 1 to 35 (M = 15.43, SD = 8.82). Years of teaching experience were classified into novice teachers and experienced teachers. According to Arzi and White (2008), teachers who have just started the teaching profession and have less than five years of teaching experience are classified as novice teachers. After five years of teaching experience, teachers who have more professional development are classified as experienced (Arzi & White, 2008). In the current study, only % 18.20 of the participants were novice teachers. The teachers have weekly 8 to 35 course hours (M = 25.36, SD = 5.45) and their avarage number of students in the classrooms varies from 10 to 45 (M = 23.23, SD = 5.12). Most of the teachers (71.9 %) are graduated from education faculty and only 61.5 of the sample graduated from science education program. A great majority of the teachers hold bachelor derees (72.4 %) and some of them hold master degree (22.9 %). For detailed information about demographic characteristics of in-service science teachers is presented in the Table 3.1.

Table 3.1 Demographic Information of Science Teachers

		Frequency (*f*)	Percentage (%)
Gender	Female	154	80.20
	Male	38	19.80
Age	23-35	72	37.50
	36-45	71	37.10
	46-55	44	23.00
	56-65	5	2.50
Years of Teaching Experience	0-5	35	18.20
	6-35	157	81.80
Graduated Faculty	Education	138	71.90
	Art & Science	54	28.10
Graduated Departmant	Science Education	118	61.50
	Physics Education	4	2.10
	Biology Education	6	3.10
	Physics	20	10.40
	Chemistry	19	9.90
	Biology	25	13.00
Graduate Level	Undergraduate	139	72.40
	Graduate	44	22.90
	PhD	9	4.70
Class Size	10-19	15	7.70
	20-25	131	68.20
	26-30	35	18.20
	31-35	9	4.70
	41-45	2	1.00
Weekly Course Hours	8-20	45	23.30
	21-25	65	33.80
	26-30	52	23.9
	31-35	30	15.5

3.3 Data Collection Instruments

In the present, data were collected by using the teacher scales consisted of six instruments, namely Demographic Information Questionnaire (see Appendix A), Teachers' Sense of Self-efficacy Scale (TSES) (see Appendix B), Sources of Self-Efficacy Inventory (SOSI) (see Appendix C), Teacher Job Satisfaction Scale (TJSS) (see Appendix D), Implicit Theory of Science Ability Scale (ITSAS) (see Appendix E), and Draw A Science Teacher Test-Checklist (DASTT-C) (see Appendix F) (see Table 3.2.). Each instrument is described in the following sections with more details.

Table 3.2 Data collection instruments and variables assessed

Instruments	**Variables**
Demographic Information Questionnaire	Gender Age Graduated Faculty Graduated Department Years of Teaching Experience Class Size Weekly Course Hours
Teachers' Sense of Self-efficacy Scale (TSES) (Tschannen-Moran & Hoy, 2001)	Student Engagement Classroom Management Instructional Strategies
Sources of Self-Efficacy Inventory (SOSI) (Adapted from Kieffer & Henson, 2000)	Mastery Experience Vicarious Experience Verbal Persuasion Physiological and Emotional States
Job Satisfaction Scale (JSS) (Skaalvik & Skaalvik, 2009)	Job Satisfaction
Implicit Theory of Science Ability Scale (ITSAS) (Adapted from Dweck & Henderson, 1988)	Implicit Theory of Science Ability
Draw A Science Teacher Test (DASTT) (Thomas, Pederson, & Finson, 2001)	(Mental Models Regarding Teaching Beliefs) Teacher-centered Student-centered (Mental Models Regarding Teaching Styles) Explicit Teaching Conceptual Teaching Exploratory Teaching

3.3.1 Demographic Information Questionnaire

The demographical questionnaire included eight questions to get information about teachers' background characteristics: gender, age, graduated faculty type, graduated department, years of teaching experience, class size, and weekly course hours.

3.3.2 Teachers Sense of Efficacy Scale (TSES)

The short version of Teachers' Sense of Self efficacy Scale, a nine-point Likert scale ranging from "1 = Nothing" to "9 = A Great Deal", was utilized to assess in-service science teachers' teaching self-efficacy. The TSES was initially developed by Tschannen-Moran and Woolfolk-Hoy (2001) taking Bandura's unpublished scale as a basis. They reported three subscales: efficacy for classroom management, efficacy for instructional strategies, and efficacy for student engagement by considering the types of tasks representative of common teaching activities. They also found that the TSES is valid for both preservice and in-service teachers.

Moreover, Tschannen-Moran and Woolfolk-Hoy (2001) developed the TSES in two versions: short version consisting of 12 items and long version consisting of 24 items. The long version of the scale includes 4 items for each subscale, whereas the short version includes 8 items. They reported that each version is a valid and reliable instrument for both preservice and in-service teachers. Moreover, Cronbah's alpha values of each subscale for both versions are close to each other, indicating high reliability (See Table 3.3).

The long version of the TSES was translated and adapted into Turkish by Capa, Cakiroglu, and Sarikaya (2005). They tested the scale with 628 preservice teachers from six different universities located in Turkey. They carried out a confirmatory

factor analysis and Rasch measurement to provide construct validity. The results revealed an acceptable model fit for each subscale (TLI = .99, CFI = .99, RMSEA = .05). In addition, Cronbah's alpha values were found as .82 for student engagement, .86 for instructional strategies, and .84 for classroom management (See Table 3.3). Therefore, the Turkish version of the scale can be regarded as a reasonable, valid, and reliable instrument to assess teachers' self-efficacy. The researchers stated that these values are acceptable for both long versions and short versions.

In the present study, the short and Turkish version of Teachers' Sense of Self efficacy Scale was utilized to assess in-service science teachers' teaching self-efficacy. The internal consistency of the items were calculated as Cronbach's alpha coefficient. In Table 3.3. descriptions of each subscale, sample items, and their alpha values are presented.

Table 3.3 Reliability Coefficients of the TSES

Subscales	Description	Sample Item	Cronbach's Alpha-Short Version (Tschannen-Moran & Hoy, 2001)	Cronbach's Alpha-Long Version (Capa, Cakıroğlu, Sarikaya, 2005)	Cronbach's Alpha-Short Version Current Study
Student Engagement	Confidence for engaging students	How much can you do to motivate students who show low interest in school work?	.81	.82	.89
Instructional Strategies	Confidence for applying variety of instructional strategies	To what extent can you use a variety of assessment strategies?	.86	.86	.87
Classroom Management	Confidence for managing classroom	How much can you do to control disruptive behavior in the classroom?	.86	.84	.86

3.3.3 Sources of Self-Efficacy Inventory (SOSI)

Sources of Self-Efficacy Inventory, which is a 7 point Likert scale ranging from "1= definitely not true for me" to "7 = definitely true for me", was used to assess in-service science teachers' sources of self-efficacy. The scale was originally developed by Kieffer and Henson (2000) based on Bandura's four hypothesized sources of self-efficacy and a model of teacher efficacy posited by Tschanen-Moran,Wolfolk-Hoy, and Hoy (1998). The SOSI consisted of 35 items assessing Bandura's four hypothesized sources of self-efficacy, namely, mastery experience (9 items), vicarious experience (9 items), social verbal persuasion (10 items), and emotional/physiological arousal (7 items). Coefficient alpha values were calculated as .71, .78, .45, and .60 for each subscale, respectively (Kieffer & Henson, 2000).

The SOSI was translated and adapted into Turkish by Çapa Aydın, Uzuntiryaki-Kondakçı, Temli, and Tarkın (2013). According to the pilot study results, after the adaptation and translation of the instrument, it consisted of 27 items: mastery experience (8 items), vicarious experience (7 items), social verbal persuasion (5 items), and emotional/physiological arousal (7 items). The instrument was administered to 302 middle school teachers from different disciplines in Turkey and confirmatory factor analyses were conducted. Results supported the four-factor structure of SOSI by the fit indices: χ^2 (318) = 757.262, *CFI* = .98, *NNFI* = .97 and *RMSEA* = .068, indicating a satisfactory model fit. In addition, the researchers found reliability coefficients as .75 for mastery experience, .78 for vicarious experience, .76 for social verbal persuasion, and .75 for physiological and emotional states (See Table 3.3). Therefore, the Turkish version of Sources of Self-Efficacy Inventory can be regarded as a reliable and valid instrument to assess teachers' sources of self-efficacy.

In the present study, the internal consistency of the items were calculated with Cronbach's alpha coefficient. Descriptions of each subscale, sample items, and their alpha values of the SOSI are given in Table 3.4.

Table 3.4 Reliability Coefficients of the SOSI

Subscales	Sample Item	Cronbach's Alpha (Kieffer & Henson, 2000).	Cronbach's Alpha (Çapa Aydın, Uzuntiryaki-Kondakçı, Temli, & Tarkın, 2013)	Cronbach's Alpha Current Study
Mastery Experience	When I make instructional mistakes, I am able to learn from the experience.	.71	.75	.81
Vicarious Experience	Watching other teachers make mistakes has taught me how to be a more efective teacher.	.78	.78	.75
Social Verbal Persuasion	Hearing that I have a talent for teaching motivates me to teach better. vp	.45	.76	.63
Physiological and emotional states	My fears of making mistakes affect my ability to teach.	.60	.75	.76

3.3.4 Teacher Job Satisfaction Scale (TJSS)

In this study, the Teacher Job Satisfaction Scale, originally developed by Skaalvik and Skaalvik (2010), was used to assess teachers' overall satisfaction with their job. The instrument consists of three items: 1- "All things considered, how much do you enjoy working as a teacher?", 2- "If you choose occupation today, would you choose to be a teacher?", and 3-"Have you ever thought about leaving the teaching profession?". For each item, a 5-point Likert scale was used, but in different responses: for the first question, ranging from "not at all" to "very much"; for the second question ranging from "no, definitely not" to "yes, without a doubt"; and for the last question, ranging from "all the time" to "never". Cronbach's alpha was found as .71 for the original scale (Skaalvik & Skaalvik, 2010).

The instrument was translated and adapted in Turkish by Yerdelen (2013). Participants were 372 science teachers working in public middle schools across Turkey. To provide construct validity confirmatory factor analysis (CFA) was conducted and a perfect model fit (χ^2 (0) = 0, p > .05) was found. Moreover, internal consistency of job satisfaction scale was examined in terms of Cronbach's alpha and was found as .87. Therefore, the Turkish version of the job satisfaction scale is deemed to be a valid and reliable measure of teachers' job satisfaction.

In the present study, the internal consistency of the items were calculated as Cronbach's alpha coefficient. Table 3.5 shows a description of the job satisfaction scale, sample item, and internal consistency coefficients.

Table 3.5 Reliability of Teacher Job Satisfaction Scale

Scale	Description	Sample Item	Cronbach's Alpha (Skaalvik & Skaalvik, 2010)	Cronbach's Alpha (Yerdelen, 2013)	Cronbach's Alpha (Current Study)
Teacher Job Satisfaction	Teachers' overall satisfaction about their job.	All things considered, how much do you enjoy working as a teacher	.71	.87	.75

3.3.5 Implicit Theory of Science Ability Scale (ITSAS)

The original version, Implicit Theory of Intelligence Scale (ITIS), was developed by Dweck and Henderson (1989) without including incremental theory items. Dweck and Henderson (1989) only include entity theory items since they suggested that incremental theory items were too attractive to give more acceptable answers. Moreover, the scale has two versions which are for children and adults. The scale

can also be converted by replacing the word 'you' with 'people', called as "others" form (Dweck, 1999: p. 178), to assess people's judgments about others. The Implicit Theory of Intelligence Scale-others form for adults version includes eight items: four for entity theory items and others for incremental theory items (Dweck, 1999: p. 178). Though four items exist in the entity part of the scale, only three of them, item 1, item 2, and item 4, have been generally utilized for adults by the researchers.

The original version of Dweck's instrument, Implicit Theory of Intelligence Scale (ITIS)-others form, was revised to the Implicit Theory of Science Ability Scale (ITSAS)-others form by Yerdelen (2013). Since individuals may have domain specific implicit theory of ability (Stipek & Grallinski, 1996), Yerdelen (2013) adapted the scale by substituting the term 'intelligence' for 'science ability' and. The similar adaptation was also done by Chen and Pajares (2010). Yerdelen (2013), also translated the instrument into Turkish. The researcher tested the adapted version with 372 in-service science teachers working in public middle schools in Turkey. In order to validate ITSAS' factor structure, Yerdelen (2013) conducted confirmatory factor analyses. According to the CFA results, the researcher eliminated item 3 from the scale because it causes poor model data fit. With the remaining 3 items, CFA results showed perfect model fit to the data ($\chi^2(0) = 0$, $p > .05$). Also, Cronbach's alpha value of the scale was found as .84 (See Table). Therefore, the Turkish version of ITSAS can be regarded as a valid and reliable scale to measure teachers' beliefs about their students' science ability.

In this study, science teachers' beliefs about individuals' science abilities were measured by using the Turkish version of Implicit Theory of Science Ability Scale (ITSAS)-others form for adults (Yerdelen, 2013). The instrument is a six-point Likert-scale ranging from "1 = strongly agree" to "6 = strongly disagree". While the high scores indicate agreement with incremental theory, low scores show agreement with entity theory. The instrument consists of four items: 1- "People have a certain

amount of science ability and they really can't do much to change it", 2- "People's science ability is something about themselves that they can't change very much', 3- "To be honest, people can't really change how much science ability they have", and 4- "People can learn new things, but they can't really change their basic science ability". In Table 3.6. description of the scale, sample item, and its alpha values are given.

Table 3.6 Reliability Coefficients of the ITSAS

Scale	Description	Sample Item	Cronbach's Alpha (Chen & Pajares, 2010)	Cronbach's Alpha (Yerdelen, 2013)	Cronbach's Alpha (Present Study)
Implicit Theory of Science Ability Scale (Entity Theory)	Teachers implicit beliefs that peoples' science abilty cannot change.	People have a certain amount of science ability and they really can't do much to change it.	.69	.84	.88

3.3.6 The Draw A Science Teacher Test Checklist

In this study, The Draw A Science Teacher Test - Checklist (DASTT-C) was used as the data collection tool in order to assess in-service science teachers mental models about their teaching practices. As its name refers, the DASTT-C focuses on science teachers and their drawings. The DAST1-C instrument has an evaluation process. Originally, Chambers (1983) developed the Draw scientist Test (DAST) to determine students' perceptions about scientists. Based on DAST, Finson, Beaver, and Charmand (1995) developed the Draw A Scientist Test - Checklist (DAST-C) to check its validity and reliability and make assessment more easily. As a further extension, the Draw A Science Teacher Test and associated checklist were developed and validated by Thomas, Pederson and Finson (2001). The instrument's internal

consistency reliability coefficient was reported as . 82 by DASTT-C developers. In this study, the internal consistency reliability is recalculated as .84.

The DASTT -C instrument consists of two main parts. The first part asks in-service science teachers to draw a picture of themselves while teaching science at work. In the second part, teachers describe their drawings by answering two questions: “What is the teacher doing?” and “What are the students doing?”. This descriptive narrative section helps the researcher to interpret the teachers’ drawings.

The instrument also has a checklist that assists the researcher in analyzing the drawings. The checklist has three categories: teacher, students and environment. The ‘teacher’ category focuses on the teacher’s activities (demonstrating, experiment, lecturing, using visual aids, etc.) and the teacher’s position (location with respect to students, and posture). The ‘student’ category focuses on the activities of students (watching and listening, and responding to teacher) and the students’ position (seated). The ‘environment’ section focuses on learning environments such as desk arrangement, teacher desk's location, laboratory equipments location, symbols of science teaching (See Table 3.7).

In the checklist each category is described with a couple of statements. If the event stated in the statement appeared in the drawing, 1 point is given. If there is not, 0 point is given. The scoring is applied to each statement. If the event does not appear in the drawing, 0 point is given, too. Each inservice teacher has a total score out of 13. According to instrument developers the total score approaching 0 means that the teacher has a student-centered teaching belief, whereas, while the score closing to 13 means that the teacher has a teacher centered teaching belief (Thomas et al., 2001). Moreover, according to the teacher's total score, their teaching style can be defined (Thomas et al., 2001). If the total score is between 0 and 4, the teacher has

an exploratory teaching style; if the total score is between 5 and 9, the teacher has a conceptual teaching style; and if the total score is between 10 and 13, the teacher has an explicit teaching style. Moreover, to make sure about the reliability of the instrument, rather than the researcher, one rater coded each drawing paper by using the checklist.

Table 3.7 The Three Components of Scoring Checklist

Component	Sub-component	Statements	Participant Score
Teacher	Activity	1.Demonstrating Experiment/Activity	
		2. Lecturing/Giving Directions (teacher talking)	
		3. Using Visual Aids (chalkboard, overhead, and charts).	
	Position	4. Centrally located (head of class)	
		5. Erect Posture (not sitting or bending down)	
Student	Activity	6. Watching and Listening (or so suggested by teacher behavior)	
		7. Responding to Teacher/Text Questions	
	Position	8. Seated (or so suggested by classroom furniture)	
Environment		9. Desks are arranged in rows (more than one row)	
		10. Teacher desk/table is located at the front of the room	
		11. Laboratory organization (equipment on teacher desk or table).	
		12. Symbols of Teaching (ABC's, chalkboard, bulletin boards, etc.)	
		13. Symbols of Science knowledge (science equipment, lab instruments, wall charts, etc.)	
Total Score			

3.4 Data Collection Procedure

The current study was conducted during the 2021- 2022 fall semester with the necessary permissions from the authors of the data collection instruments, the METU Human Research Ethics Committee (see Appendix G), and the Ministry of Education of Turkey (see Appendix H). After getting necessary permissions, the data collection instruments were administered to 192 science teachers in Gölbaşı and Çankaya districts of Ankara. In the study, 27 middle schools involved. The participants were informed about the study and ensured that their responses to the instruments will be kept confidential. All the participants were volunteers and any of them unwilling to participate was not forced to fullfill the instruments. The participants fill out the instruments in twenty minutes. The data collection procedure is completely managed by the researcher.

3.5 Data Analysis Procedure

In the present study, the descriptive and inferential statistical analyses were conducted using the 'SPSS 15' software program. The collected data were analyzed using preliminary analysis, descriptive and inferential statistics. As preliminary analysis, data cleaning, outlier and assumption controls were done. As part of the descriptive statistics, mean, standard deviations, skewness and kurtosis etc. were calculated to identify demographic information of the science teachers. Multiple regression analysis and multivariate analyses of variance (MANOVA) techniques were used for inferential statistics. Multiple regression analysis was used to examine how well proposed sources predict teachers' sense of self-efficacy, and also used to how well teachers' sense of self-efficacy predict teachers' student-centered teaching beliefs. Moreover, MANOVA was carried out to examine whether in-service science teachers' teaching self-efficacy differs with respect to their teaching style.

3.6 Assumptions and Limitations

3.6.1 Assumptions

1. The administration of the instruments was conducted under standard conditions in each school.
2. The teachers filled out the questions honestly.
3. The teachers did not interact with each other during the instruments' administration process.
4. The characteristics of the study sample were assumed to be representative of the population.

3.6.2 Limitations

Although the current research can give insight into sources and consequences of the science teachers' teaching self-efficacy, there are some limitations that need to be addressed to take into account in future research. Firstly, the present study just relied on science teachers' teaching self-efficacy. This study can be expanded to other domains such as mathematics, music education, etc. Secondly, the data collection tools mainly consist of self-report instruments. Although there is also a drawing-based instrument that could potentially discover teachers' mental beliefs, future studies can use interviews or observations to make deep investigations. Thirdly, in the current study, the research design was cross-sectional. Future studies can utilize a longitudinal study design. Future studies may try to reveal whether a relationship between teaching self-efficacy and the proposed sources changes over time, and if it does, what kind of changes occurs by using longitudinal study design.

3.7 Internal and External Validity

3.7.1 Internal Validity

Internal validity refers to the differences in the dependent variable acquired in a research study due to the independent variable not being caused by other unrelated variables (Fraenkel & Wallen, 2006). This section discussed possible threats to internal validity and the methods to deal with them.

For the present study, subject characteristics might be a threat since the results might be explained by teachers' other characteristics such as gender, socioeconomic status, and age.

Location and instrumentation could not be a threat for the current study because the researcher applied the instruments to all participant teachers in their own schools.

Additionally, data collector characteristics could not be a threat to the study since the researcher herself collected all the data.

However, instrument decay might be a threat to the research, especially while scoring the DASTT-C instrument drawings. In order to prevent this threat scoring the drawings was done by the researcher and an independent rater who was a graduate student in the measurement and assessment program. The independent rater was trained about the scoring. Any inconsistencies between the researcher and the independent rater were resolved through discussions.

Lastly, testing can be a threat to the present study to the internal validity since in the cross-sectional correlation studies, teachers' responses to an instrument might be affected by their responses to the previous instrument. In the current study, all the instruments were administrated to the participant teachers at the same time so that they might make a connection between the items.

3.7.2 External Validity

External validity refers to how generalizable the findings of the research are (Fraenkel & Wallen, 2006). The convenience sampling method was used in the present study because of transportation, money, and time restrictions. Therefore; the representativeness of the sample might be affected by the sample selection method. The data collected from 27 middle schools in Çankaya and Gölbaşı districts in Ankara. Although the sampling method is convenient, the relatively large sample enables the study findings' generalizability.

CHAPTER 4

RESULTS

This chapter presents the results of the statistical analyses conducted for the related research questions. The results are organized into two sections. The first section presents descriptive statistics. The second section includes inferential statistics for the relationship between teachers' self-efficacy and its sources and the relationship between teachers' self-efficacy and its consequences.

4.1 Descriptive Statistics

In the present study, in-service science teachers' teaching self-efficacy was measured by using the Teacher Sense of Efficacy Scale (TSES) with the subscales Efficacy for Student Engagement (TSESE), Efficacy for Instructional Strategies (TSEIS), and Efficacy for Classroom Management (TSECM). Also, teacher self-efficacy sources were measured through administration of Teacher Job Satisfaction Scale (TJSS), Implicit Theory of Science Ability Scale (ITSA), Sources of Self-efficacy Inventory (SOSI) with the subscales Mastery Experience (ME), Vicarious Experience (VE), Verbal Persuasion (VP), and Physiological and Emotional States (PES). Additionally, teacher self-efficacy consequence was measured via Draw a Science Teacher Test-Checklist (DASST-C). The DASST-C was used to determine Teachers' Mental Models (TMental) regarding their Teaching Beliefs (TB). In addition, science teachers' Teaching Style (TS) was also determined by DASST-C. Descriptive statistics were presented in this part of the study.

As descriptive statistics means, standard deviations, skewness, and kurtosis values for the variables are presented in the Table 4.1. According to skewness and kurtosis,

all variables vary between the critical values -2 and +2 as suggested so that all variables could be accepted as normally distributed.

Table 4.1 Descriptive Statistics for Study Variables

	Min.	Max.	Mean	S.D.	Skewness	Kurtosis
TJS (Teacher Job Satisfaction)	2.00	5.67	4.47	1.10	-.63	.26
ITSA (Implicit Theory of Science Ability)	1.00	7.00	4.51	1.05	-.88	.73
TSECM (Teacher Self-efficacy -Classroom Management)	5.00	9.00	7.39	.92	-.16	-.47
TSESE (Teacher Self-efficacy- Student Engagement)	4.00	9.00	7.16	1.04	-.34	.19
TSEIS (Teacher Self-efficacy- Instructional Strategies)	4.50	9.00	7.40	.94	-.29	-.01
ME (Sources of Self-Efficacy- Mastery Experience)	3.25	7.00	6.14	.61	-1.34	1.19
VE (Sources of Self-Efficacy- Vicarious Experience)	2.71	6.71	5.25	.94	-.25	-.59
VP (Sources of Self-Efficacy- Verbal Persuasion)	2.80	7.00	5.70	.79	-.91	1.67
PES (Sources of Self-Efficacy-Physiological-Emotional States)	1.71	7.00	4.08	1.11	-.07	-.25
TMental (Teachers' Mental Models)	1.00	13.00	7.23	3.56	-.28	.17

4.1.1 Descriptive Statistics for Teacher Sense of Self-efficacy

In-service science teachers' teaching self-efficacy is measured by the Teachers' Sense of Efficacy Scale (TSES), developed by Tschannen-Moran and Woolfolk-Hoy (2001). The scale is a 9 point Likert type and ranges from "1 = nothing" to "9 = a great deal". It includes three subscales: Teacher Self-efficacy for Classroom Management (TSECM), Teacher Self-efficacy for Student Engagement (TSESE), and Teacher Self-efficacy for Instructional Strategies (TSEIS). Each subscale consists of 4 items. As seen in Table 4.2., descriptive statistics for each subscale are presented. Teacher Self-efficacy for Instructional Strategy had the highest subscale mean (M = 7.40, SD = .94) and Teacher Self-efficacy for Student Engagement (M =

7.16, SD = 1.04) had the lowest subscale mean. These findings imply that in-service science teachers' belief in applying instructional strategies is relatively high (M = 7.40 out of 9). Although their belief in their abilities to engage students in science class is fairly high (M = 7.16 out of 9), it is the lowest among other subscales in the scale. Moreover, science teachers' belief in their ability for classroom management is fairly high (M = 7.39 out of 9).

Table 4.2 Descriptive Statistics for TSES Subscales

	M	SD
TSECM	7.39	.91
TSESE	7.16	1.04
TSEIS	7.40	.94

Moreover, Table 4.3 presents the item-level investigations of teacher sense of self-efficacy for classroom management subscale below. Results indicate that most participants selected "A Great Deal" end of the scale, and there was no selection for the "Nothing" option. For example, when "A Great Deal" and "Quite Enough" responses are combined; 85.40 % of the participant teacher selected great deal option for the item 6 that "How much can you do to get children to follow classroom rules?.". These results also demonstrated that the participant tearchers' belief about their ability to manage their classroom is very high.

Table 4.4 shows the item-level investigations of teacher sense of self-efficacy for student engagement subscale below. Results show that most participants selected the "A Great Deal" option of the scale. No participant was selecting the "Nothing" option. For example, when "A Great Deal" and "Quite Enough" responses are joined; more than three-quarter of the participants (80.20 %) selected "great deal" option for the item 4 "How much can you do to help your students value learning ? ". These results also demonstrated that the participant tearchers' belief about their ability to engage their students to learn science lessons is very high.

In addition, Table 4.5 shows the item-level investigations of teacher sense of self-efficacy for instructional strategies subscale below. Results indicate that most participants selected the “A Great Deal” option, and no participant selected the “Nothing” option. For example, if “A Great Deal” and “Quite Enough” responses are joined; 88.10 % of the participant teacher are selected great deal option for the item 10 : “To what extent can you provide an alternative explanation or example, when students are confused? ”. These results also demonstrated that the participant tearchers’ belief about their capability to provide alternative explanations to their students is at a very high level.

Table 4.3 Descriptive statistics of the items of the TSES for Classroom Management

			Percentage (%)								
			Nothing								A Great Deal
Items	*M*	*S.D.*	1	2	3	4	5	6	7	8	9
1. How much can you do to control disruptive behavior in the classroom?	7.40	1.05	0.00	0.00	0.00	0.00	4.70	9.90	45.80	20.30	19.30
6. How much can you do to get children to follow classroom rules?	7.56	1.04	0.00	0.00	0.00	0.50	1.60	12.50	33.30	31.30	20.80
7. How much can you do to calm a student who is disruptive or noisy?	7.46	1.86	0.00	0.00	0.00	0.00	3.60	14.60	34.90	26.00	20.80
8. How well can you establish a classroom management system with each group of students?	7.18	1.18	0.00	0.00	0.50	0.00	7.80	19.30	30.70	28.10	13.50

Table 4.4 Descriptive statistics of the items of the TSES for Student Engagement

			Percentage (%)								
			Nothing								A Great Deal
Items	*M*	*S.D.*	1	2	3	4	5	6	7	8	9
2. How much can you do to motivate students who show low interest in school work?	7.17	1.27	0.00	0.00	2.10	2.10	4.20	12.00	42.20	22.40	15.10
3. How much can you do to get students to believe they can do well in school work?	7.29	1.25	0.00	0.00	0.00	3.10	5.20	14.10	33.30	25.50	18.80
4. How much can you do to help your students value learning?	7.33	1.04	0.00	0.00	0.00	0.50	2.60	16.70	38.00	27.60	14.60
11. How much can you assist families in helping their children do well in school?	6.84	1.25	0.00	0.00	1.60	2.60	5.70	28.60	33.30	18.20	9.90

Table 4.5 Descriptive statistics of the items of the TSES for Instructional Strategies

			Percentage (%)								
			Nothing								A Great Deal
Items	*M*	*S.D.*	1	2	3	4	5	6	7	8	9
5. To what extent can you craft good questions for your students?	7.24	1.86	0.00	0.00	0.00	1.00	3.60	17.70	39.60	23.40	14.60
9. How much can you use a variety of assessment strategies?	7.26	1.17	0.00	0.00	0.00	2.10	6.30	13.00	34.90	29.70	14.10
10. To what extent can you provide an alternative explanation or example, when students are confused?	7.65	1.06	0.00	0.00	0.00	0.50	3.10	8.30	30.20	33.90	24.00
12. How well can you implement alternative strategiesin your classroom?	7.46	1.82	0.00	0.00	0.00	0.00	5.20	11.50	34.40	30.20	18.80

4.1.2 Descriptive Statistics for Sources of Self-efficacy Inventory

In-service science teachers' sources of self-efficacy were measured by using the Sources of Self-efficacy Inventory, which is a 7 point Likert scale ranging from "1= definitely not true for me" to "7 = definitely true for me", developed initially by Kieffer and Henson (2000). The scale is based on Bandura's four hypothesized sources of self-efficacy and was translated and adapted into Turkish by Çapa Aydın, Uzuntiryaki-Kondakçı, Temli, and Tarkın (2013). It consisted of four subscales: Mastery Experience (ME) (8 items), Vicarious Experience (VE) (7 items), Verbal Persuasion (VP) (5 items), and Physiological and Emotional states (PES) (7 items). As seen in Table 4.6., descriptive statistics for each subscale are presented. Mastery Experience had the highest subscale mean (M = 6.14, SD = .61) and Physiological and Emotional states (M = 4.08, SD = 1.12) had the lowest subscale mean. These findings imply that in-service science teachers' belief about developing their capabilities from their past experiences is quite high (M = 6.14 out of 7). Although their judgments about their self-efficacy affected by their physiological and emotions are fairly high (M = 4.08 out of 7), it is the smallest among other subscales in the scale. Moreover, science teachers' development of their self-efficacy beliefs from observing other teachers' experiences (M = 5.20 out of 7) and from other teachers' verbal judgments about them is also relatively high (M = 5.70 out of 7).

Table 4.6 . Descriptive Statistics for the SOSI Subscales

	M	SD
ME	6.14	.61
VE	5.20	.94
VP	5.70	.79
PES	4.08	1.12

Moreover, Table 4.7 shows the item-level descriptive statistics of teachers' sources of self-efficacy inventory for the mastery experience below. According to the results, most of the participants selected the "definetly ture" option for the scale items, and there is nearly no selection for the "definetly not true" option. For example, when "definetly ture" and "true" responses are combined, 86.90 % of the participant teacher think definitely true that "When I make instructional mistakes, I am able to learn from the experience." (Item 15). These results also demonstrated that the participant teachers' teaching self-efficacy is affected by their past experiences.

Table 4.8 presents the item-level descriptive statistics of teachers' sources of self-efficacy inventory for the vicarious experience subscale below. Results show that most participants selected the "definetly true" option for the items. For example, when "definetly ture" and "true" responses are combined; 59.30 % of the participant teachers think true that "Listening to others talk about teaching gives me useful information on teaching." (Item 2), and also 45.70 % of them think true that "Watching other teachers make mistakes has taught me how to be a more efective teacher." (Item 5). These results also indicate that the participant tearchers' teaching self-efficacy is influenced by other teachers' experiences.

Additionally, Table 4.9 shows the item-level descriptive statistics of teachers' sources of self-efficacy inventory for verbal persuasion. According to the results, most participants selected the "definetly true" option for the items. For example, when "definetly ture" and "true" responses are combined, 78.10 % of the participant teacher think definitely true that "Hearing that I have a talent for teaching motivates me to teach better." (item 14). These results also show that participants' teaching self-efficacy is affected by others' judgments about their teaching profession.

Table 4.10 shows the item-level descriptive statistics of teachers' sources of self-efficacy inventory for physiological and emotional states subscale. Results show that participants' responses showed similar patterns across the items except for item 7 and item 13. Most of the participants choose the "definetly not true" option for these items. For example, when "definetly not true" and " not true" responses are combined, 84.40 % of the participant teacher think definitely untrue that ". When I say the wrong things to a class, I become anxious.."(item 4). However, These results also indicate that the participant tearchers' teaching self-efficacy is affected by their physiological and emotional states.

Table 4.7 Descriptive statistics of the items of the SOSI for Mastery Experience

			Percentage (%)						
			definitely not true						definitely true
Items	*M*	*S.D.*	1	2	3	4	5	6	7
1.I have had many positive oportunities to teach.	5.81	0.84	0.00	0.00	1.00	1.00	37.50	37.00	23.40
6. I remember clearly those times when I have taught groups well.	6.78	1.10	0.00	1.00	4.20	3.60	10.40	38.50	42.20
9.I have learned a great deal from teaching in clasroms.	6.40	0.81	0.00	0.00	1.00	0.00	14.60	26.00	58.30
11.My clasrom observations are valuable to me.	6.24	0.76	0.00	0.00	0.00	2.10	13.00	43.20	41.70
15. When I make instructional mistakes, I am able to learn from the experience.	6.26	0.92	1.00	0.00	0.00	2.60	9.40	41.10	45.80
17. My course work has helped me develop efective teaching strategies and skils.	6.29	0.74	0.00	0.00	0.00	2.60	9.40	44.30	43.80
20. Teaching well gives me a positive sense of personal success.	5.70	1.22	1.00	1.00	4.20	7.30	20.30	39.10	27.10
25. I have developed many of my teaching skils by actualy teaching.	6.34	0.89	0.00	0.00	1.00	3.60	10.90	28.60	55.70

Table 4.8 Descriptive statistics of the items of the SOSI for Vicarious Experience

			Percentage (%)						
			definitely not true						definitely true
Items	*M*	*S.D.*	1	2	3	4	5	6	7
2. Listening to others talk about teaching gives me useful information on teaching.	5.71	1.09	0.00	1.00	1.00	11.50	27.10	30.70	28.60
5.Watching other teachers make mistakes has taught me how to be a more efective teacher.	5.28	1.66	5.20	3.20	7.30	8.90	19.80	30.20	25.50
8. I have had meaningful oportunities to observe teachers in action.	4.70	1.76	3.60	13.00	9.40	15.60	17.20	25.50	15.60
12. I have learned about how to be a teacher by watching other skilful teachers.	5.40	1.38	0.00	3.10	6.30	15.60	24.00	21.90	29.20
18. I have developed confidence in my own teaching by observing the mistakes that other teachers make.	5.09	1.66	4.20	6.30	4.20	19.30	16.10	28.10	21.90
21. When I see other teachers doporly,I am able to learn how to teach more efectively.	5.09	1.47	1.00	6.30	9.40	11.50	24.00	32.80	15.10
26. I learn litle about how to actualy teach efectively from sugestions of others.	5.47	1.34	1.00	3.10	3.10	14.60	21.90	31.80	24.50

Table 4.9 Descriptive statistics of the items of the SOSI for Verbal Persuasion

			Percentage (%)						
			definitely not true						definitely true
Items	*M*	*S.D.*	1	2	3	4	5	6	7
3. The fedback I receive from others helps me feel beter.	5.73	1.63	1.00	0.50	2.10	5.20	24.50	45.30	21.40
10. When people I respect tell me I will be a good teacher, I tend to believe them.	6.11	1.00	0.50	0.50	1.60	2.10	15.10	40.10	40.10
14. Hearing that I have a talent for teaching motivates me to teach better.	6.98	1.24	2.10	1.00	2.60	2.10	14.10	39.60	38.50
19. When other teachers say that I am a good teacher, iy motivates me to teach better.	5.62	1.36	2.10	1.00	4.20	10.90	19.30	32.30	30.20
23. I often get important feedback from experienced persons about my teaching ability.	5.06	1.55	3.10	2.60	12.00	16.70	16.10	32.30	17.20

Table 4.10 Descriptive statistics of the items of the SOSI for Physiological and Emotional States

			Percentage (%)						
			definitely not true						definitely true
Items	*M*	*S.D.*	1	2	3	4	5	6	7
4. When I say the wrong things to a class, I become anxious.	6.00	1.40	1.00	2.10	5.20	6.80	10.40	21.90	52.60
7. The idea of being in a clasrom as a teacher makes me nervous.	1.74	1.39	64.60	19.80	6.30	2.60	1.60	3.10	2.10
13. My fears of making mistakes affect my ability to teach.	2.63	1.69	31.80	31.30	8.30	10.40	9.90	6.30	2.10
16. Not being able to communicate with students scares me.	4.55	2.17	16.10	9.40	8.30	2.60	19.30	21.90	22.40
22. When I have made mistakes teaching, I have felt my heart beat faster and harder.	4.14	1.77	8.90	9.40	18.80	24.00	11.50	16.70	10.90
24. I get excited when I do something right to help a child learn.	4.74	1.82	7.80	6.30	11.50	12.50	21.90	20.80	19.30
27. I worry when I can't get students to participate in the lesson.	4.78	1.86	7.30	8.90	9.40	12.00	17.70	25.00	19.80

4.1.3 Descriptive Statistics for Teacher Job Satisfaction Scale

In-service science teachers' overall satisfaction with their job was investigated using the Teacher Job Satisfaction Scale, originally developed by Skaalvik and Skaalvik (2010). The translated and adapted version of the instrument (Yerdelen, 2013) consists of three items: 1- "All things considered, how much do you enjoy working as a teacher?", 2- "If you choose occupation today, would you choose to be a teacher?", and 3-"Have you ever thought about leaving the teaching profession?". For each item, a 5-point Likert scale was used, but in different responses: for the first question, ranging from "1= not at all" to "6 = very much"; for the second question ranging from "1 = no, definitely not" to "6 = yes, without a doubt"; and for the third question, ranging from "1 = never" to "6 = all the time". As seen in Table 4.11., descriptive statistics for the scale, the mean score was M = 4.47 (SD = 1.10). This result means that science teachers mostly agreed that they were pleasant from being in the teaching profession. Moreover, Table 4.12 presents the teacher job satisfaction scale's descriptive statistics for each item.

Table 4.11 Descriptive Statistics for the TJSS

	M	SD
TJS	4.47	1.10

The item level analysis of teacher job satisfaction scale (See Table 4.12) shows that item 1 has the largest mean (M = 4.68, SD = 1.08) with the 60.40 % of the participants give answers close to "All the time" (i.e., options 5 & 6) and 26 % of the participant selected option 4. On the other hand, only 2.60 % of the teachers chose the options close to never (i.e., options 1 &2), which indicates that most of the participant teachers appear to enjoy their job. When item 3 is examined, it seems that the mean score is the smallest (M = 4.58, SD = 1.44), with more than half of the participants (56.5 %) selecting options close to "Never" (i.e., options 1 & 2), which

suggests that the teachers do not tend to quit their teaching profession. Only 9.4 % of the participants selected the options close to “All the time” (i.e., options 5 & 6).

Table 4.12 Descriptive Statistics for the TJSS Items

			Percentage (%)					
			Never					All the time
Items	*M*	*S.D.*	1	2	3	4	5	6
1. All things considered, how much do you enjoy working as a teacher?	4.68	1.08	1.00	1.60	10.90	26.00	34.90	25.50
2.If you choose occupation today, would you choose to be a teacher?	4.15	1.49	9.40	4.70	14.10	25.50	26.00	20.30
3.Have you ever thought about leaving the teaching profession?	4.58	1.44	4.70	4.70	12.00	22.90	17.70	38.00

4.1.4 Descriptive Statistics for Implicit Theory of Sicence Ability Scale

In this study, science teachers’ beliefs about individuals’ science abilities, whether incremental or entity, were measured by using the Turkish version of Implicit Theory of Science Ability Scale (ITSAS)-others form adapted by Yerdelen (2013). The instrument is a six-point Likert scale ranging from “1 = strongly agree” to “6 = strongly disagree” with the four items. These items are based on only entity theory. According to the results, while the high scores indicate agreement with incremental theory, low scores indicate agreement with entity theory.

As presented in Table 4.13., descriptive statistics for the scale, the mean score was M = 4.51 out of 6 (SD = 1.05). This result means that science teachers mostly believe that people’s science ability is not fixed. Additionally, Table 4.14 presents the

descriptive statistics of teachers' implicit theory of the science ability scale for each item.

Table 4.13 Descriptive Statistics for the ITSAS

	M	SD
ITSA	4.51	1.05

Additionally, Table 4.14 presents the descriptive statistics of teachers' implicit theory of the science ability scale for each item below. According to the results, most of the participants are "strongly disaggree" with the items of the scale. For example, when "strongly disagree," and responses of 5 and 6 are combined, 70.30 % of the participant teacher disagreed with the statement, "To be honest, people can't really change how much science ability they have.". These results also demonstrated that the participant teachers tend the hold the belief that science ability is malleable.

Table 4.14 Descriptive Statistics for the ITSAS Items

			Percentage (%)					
			Strongly Agree					Strongly Disagree
Items	*M*	*S.D.*	1	2	3	4	5	6
1.People have a certain amount of science ability and they really can't do much to change it.	4.43	1.19	1.00	6.30	16.70	17.70	42.20	15.60
2.People's science ability is something about themselves that they can't change very much.	4.58	1.16	2.10	4.20	11.50	16.70	47.40	17.70
3.To be honest, people can't really change how much science ability they have.	4.68	1.21	2.10	5.70	8.30	13.00	47.90	22.40
4. People can learn new things, but they can't really change their basic science ability.	4.33	1.30	1.00	10.40	19.30	9.90	43.20	15.60

4.1.5 Descriptive Statistics for Draw A Science Teacher Test - Checklist

In this study, the Draw A Science Teacher Test Checklist (DASTT-C) was used to measure in-service science teachers' mental models about their teaching beliefs regarding student-centered and teaching-centered. In this instrument, participant teachers draw themselves as a teacher and their students in their learning environment. After administering the test, by using a checklist, teachers' drawings were scored by the rater. While scoring, the rater read the statements on the checklist. If the event stated in the statement appeared in the drawing, 1 point is given. If there is not, 0 points are given. The scoring is applied to each statement. If the event does not appear in the drawing, 0 points are given, too. Each inservice teacher has a total score out of 13. Table 4.15 presents two examples of scores allocated to one teacher (T1) who has teacher-centered teaching belief and another teacher (T2) who has student-centered teaching belief. In addition, Figure 4.1 shows the teacher's (T1) drawings, and Figure 4.2 shows the teacher's (T2) drawings. According to instrument developers, teachers' mental model total scores approaching 0 mean that the teacher has a student-centered teaching belief. The scores are close to 13 means that the teacher has a teacher-centered teaching belief (Thomas et al., 2001). In this study, the total score mean is calculated as 7.23 out of 13 (SD = 3.36). This result means that in-service science teachers mostly have teaching beliefs on teacher-centered classroom practices.

Moreover, according to the teachers' mental model total scores, their teaching style can also be defined (Thomas et al., 2001). It can be supposed that if the total score is between 0 and 4, the teacher has an exploratory teaching style; if the total score is between 5 and 9, the teacher has a conceptual teaching style; and if the total score is between 10 and 13, the teacher has an explicit teaching style. The Figure 4.1. presents the teacher (T1) who has an explicit teaching style, the Figure 4.2. shows the teacher (T2) who has an exploratory teaching style and the Figure 4.3. shows the teacher

(T3) who has conceptual teaching. According to the results, 61 teachers have exploratory teaching style (31.8 %), 67 teachers own conceptual teaching style (34.9 %), and 64 teachers have explicit teaching style (33.3 %).

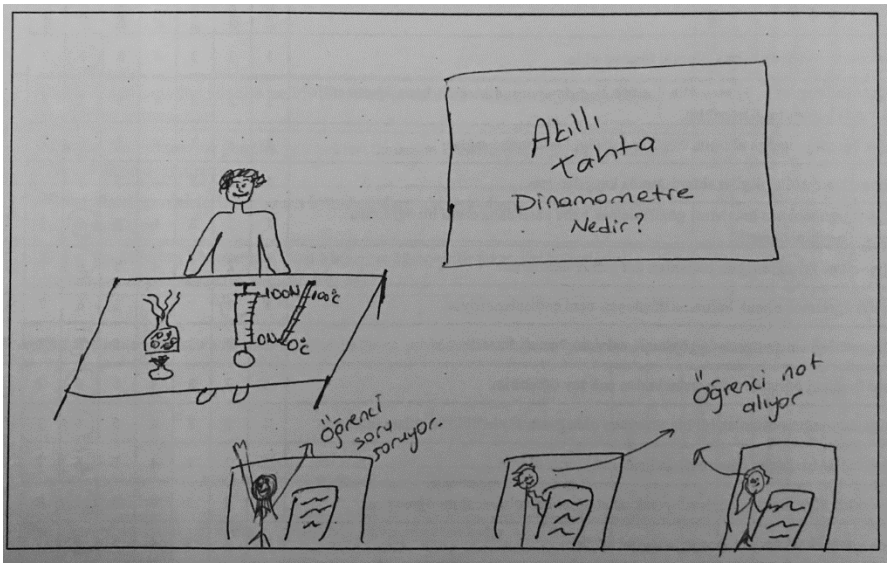

Figure 4.1. Drawing of the Teacher (T1) with the total score 12

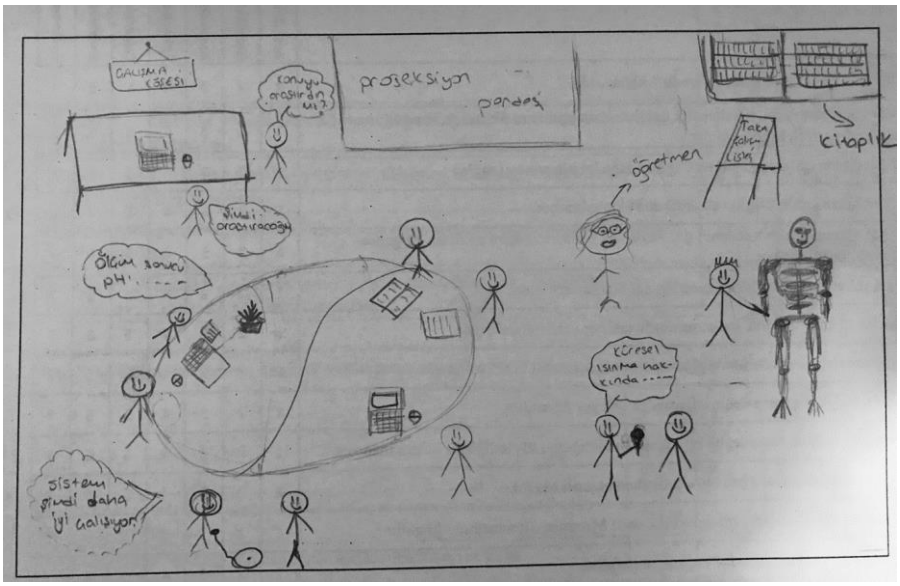

Figure 4.2. Drawing of the Teacher (T2) with the total score 0

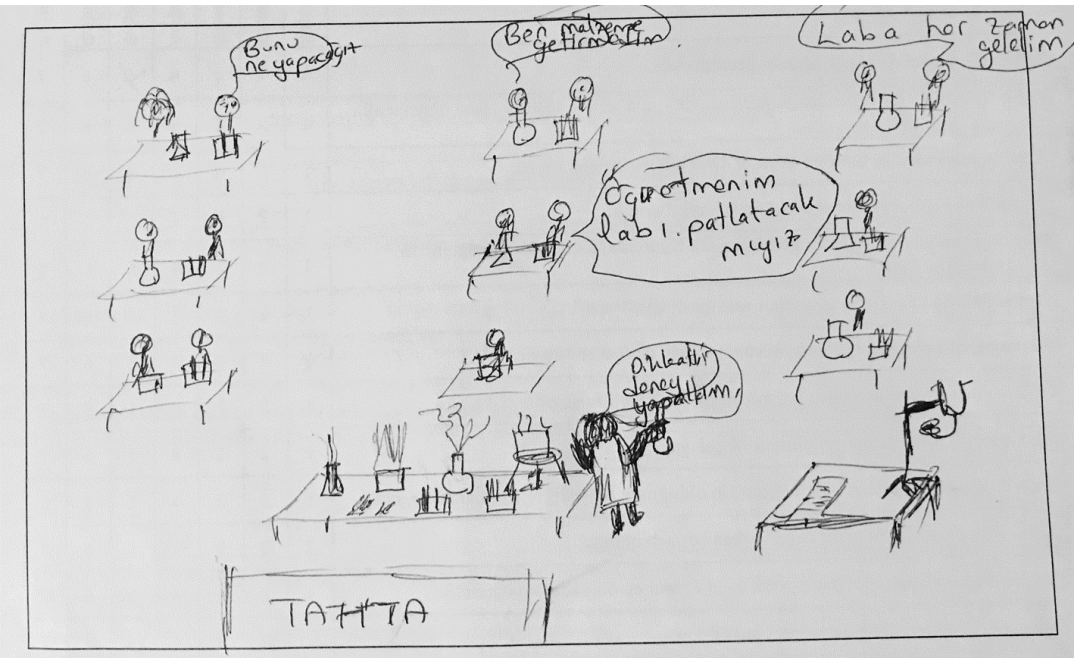

Figure 4.3. Drawing of the Teacher (T3) with the total score 8

Table 4.15 Checklist and and a Sample Scoring Table

Component	Sub-component	Statements	T1 Score	T2 Score
Teacher	Activity	1.Demonstrating Experiment/Activity	1	0
		2. Lecturing/Giving Directions (teacher talking)	1	0
	Position	3. Using Visual Aids (chalkboard, overhead, and charts).	1	0
		4. Centrally located (head of class)	1	0
		5. Erect Posture (not sitting or bending down)	1	0
Student	Activity	6. Watching and Listening (or so suggested by teacher behavior)	1	0
		7. Responding to Teacher/Text Questions	0	0
	Position	8. Seated (or so suggested by classroom furniture)	1	0
Environment		9. Desks are arranged in rows (more than one row)	1	0
		10. Teacher desk/table is located at the front of the room	1	0
		11. Laboratory organization (equipment on teacher desk or table).	1	0
		12. Symbols of Teaching (ABC's, chalkboard, bulletin boards, etc.)	1	0
		13. Symbols of Science knowledge (science equipment, lab instruments, wall charts, etc.)	1	0
Total Score			12	0

4.2 Inferential Statistics

In order to address the first two research questions, multiple regression analyses were conducted. For the third research question, multivariate analysis of variance (MANOVA) was carried out. For the first research question, there were three sub-questions. Accordingly, three separate multiple regression analyses were conducted. To control for type I error, an adjustment was made in alpha level, and significance values were evaluated against the adjusted alpha value of .017 (.05/3). For the second and third research questions, the alpha level was set as .05.

4.2.1 Results of Research Question 1: Teacher Self-efficacy and the Sources

In this part of the study, the first reseach question consisted of three sub-questions. Therefore, the three set of different multiple regression analyses were performed to provide solutions for the reseach sub-questions which are related to science teachers' teaching self-efficacy and its sources.

1. How well do the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self-efficacy ?

> 1.1: How well do the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self-efficacy for classroom management?
>
> 1.2 How well do the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and

physiological states) predict in-service science teachers' teaching self-efficacy for student engagement?

1.3. How well do the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self-efficacy for instructional strategies?

4.2.1.1 Results of Research Question 1.1: Teacher Self-efficacy for Classroom Management

1.1: How well do the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self-efficacy for classroom management?

Ho 1.1: There is no significant contribution of the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) in the prediction of in-service science teachers' teaching self-efficacy for classroom management.

The dependent variable for the question was teachers' teaching self-efficacy for classroom management and the independent variables were years of experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states.

4.2.1.1.1 Assumptions of Reseach Question 1.1

4.2.1.1.1.1 Sample Size

The sample size of the research was enough to conduct multiple regression analysis as calculated by using the formula N > 50 + 8.k as suggested by Tabachnick and Fidell (2007). In this formula, k represents the number of independent variable numbers. The first research question has seven independent variables. When calculating the formula, the number of participants should be a minimum of 106. Since the number of participant teachers who attended the study was 192, there is no violation for sample size. Moreover, this assumption is acceptable for all subquestions of the first research question.

4.2.1.1.1.2 Outliers

Multivariate outliers were detected via Mahallanobis' distance outlier screening procedure. The critical chi-square at alpha=.001 for "7" df is 24.32 (Tabachnick & Fidell, 2007). According to the results, Mahallanobis' distance value was 25.90. Therefore, five cases exceeding the critical value of 24.32 were identified as potential outliers. However, according to Tabachnick and Fidell (2007), cases with Cooks' distance values larger than 1 are a potential problem. In the analysis, the maximum value for Cooks' Distance was .145, suggesting that the cases were not influential on the regression equation. Thus, the cases were decided to be retained.

In addition, outliers for a dependent variable were analyzed concerning a standardized residual scatterplot. The minimum standardized residual value was -2.323, and the maximum standardized residual value was 3.129. Since these values are between -3.3 and 3.3 (Tabachnick & Fidell, 2007), there were no outliers on the dependent variable.

4.2.1.1.1.3 Multicollinearity

The bivariate correlations among the independent variables were calculated (See Table 4.16). All Pearson Correlation coefficients between independent variables were below 0.8, showing no multicollinearity. Moreover, Tolerance and VIF values are also calculated, as shown in Table 4.17. According to the results, Tolerance values are not below .10, and VIF values are below 10. Therefore there is no violation of the multicollinearity assumption.

Table 4.16 Correlations

		TSECM	TEXPER	JS	ITSA	ME	VE	VP	PES
Pearson Correlation	TSECM	1.000							
	TEXPER	.071	1.000						
	JS	.185	.039	1,000					
	ITSA	.219	.015	.039	1.000				
	ME	317	-.134	.310	.061	1.000			
	VE	.058	-.069	.341	.154	.523	1.000		
	VP	.084	-.021	.342	.150	.502	.767	1.000	
	PES	-.231	-.035	.086	.026	.090	.303	.323	1.000

Table 4.17 Collinearity Statistics

Independent Variables	Tolerance	VIF
TEXPER	.896	1.151
JS	.741	1.350
ITSA	.967	1.034
ME	.658	1.520
VE	.376	2.661
VP	.358	2.793
PES	.874	1.144

4.2.1.1.1.4 Normality, Linearity, Homoscedasticity and Independence of Residuals

These assumptions were checked by examining standardized residual scatterplots and it was found that there is no violation of the normality, linearity, and homoscedasticity of residual assumptions (See Figure 4.4).

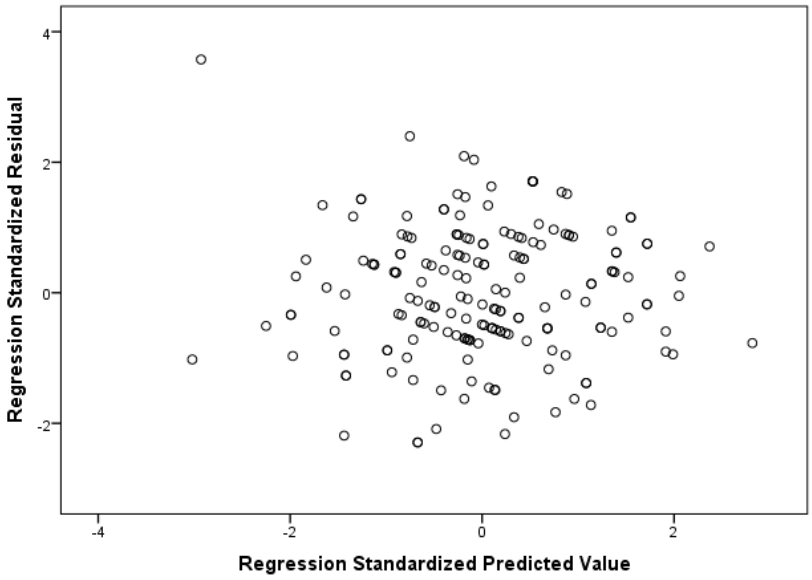

Figure 4.4. Scatterplot for Teacher Self-efficacy for Classroom Management

The independence of the residuals assumption was tested using the Durbin-Watson value, which should vary between 1.5 and 2.5, indicating satisfaction of the assumption. Accordingly, the Durbin-Watson value found as 1.93 demonstrated that there was no violation of the assumption (See Table 4.18).

4.2.1.1.2 Evaluating the Model

Multiple linear regression analyses results showed that the combination of the predictor variables was significantly related to the dependent variable F (7, 184) = 8.02, p <.017. The sample multiple correlation coefficient was .48, indicating that approximately 23.4 % of the variance of teacher self-efficacy for classroom management can be explained by the combination of independent variables (See Table 4.18).

Table 4.18 Model Summary for Classroom Management

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.478	.234	.199	.81831	1.929

More specifically, it was found that the mastery experience variable (beta= .37, sr square = .091, p<.017) explaining 9.1 % of variance uniquely made the strongest statistically significant contribution to the prediction of teaching self-efficacy for classroom management when the other variables were controlled. Moreover, physiological and emotional states (beta= .24, sr square = .051, p <.017) explaining 5.1 % of variance uniquely and implicit theory of science ability (beta = .21, sr square = .042, p <.017) explaining 4.2 % of variance uniquely made also a statistically significant contribution to the prediction of in-service science teachers' teaching self-efficacy for classroom management. Whereas years of experience, job satisfaction, vicarious experiences, and verbal persuasions failed to achieve statistically significant contribution (p > .017) (See Table 4.19).

Table 4.19 Coefficients

Independent Variables	Beta	Sig.	sr^2
Year	.078	.260	.005
TJS	.084	.262	.005
ITSA	.209	.002	.042
ME	.372	.000	.091
VE	-.113	.283	.004
VP	.033	.752	.004
PES	-.240	.001	.051

4.2.1.2 Results of Research Question 1.1: Teacher Self-efficacy for Student Engagement

1.2 How well do the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self-efficacy for student engagement?

Ho 1.2: There is no significant contribution of the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) in the prediction of in-service science teachers' teaching self-efficacy for student engagement.

The dependent variable for the question was teaching self-efficacy for student engagement. The independent variables were years of experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states.

4.2.1.2.1 Assumptions of Reseach Question 1.2

4.2.1.2.1.1 Outliers

Multivariate outliers were detected via Mahallanobis' distance outlier screening procedure. The critical chi-square at alpha=.001 for "7" df is 24.32 (Tabachnick & Fidell, 2007). According to the results, Mahallanobis' distance value was 25.90. Therefore, five cases exceeding the critical value of 24.32 were potential outliers. However, Cooks' distance values larger than 1 are a potential problem (Tabachnick & Fidell, 2007). According to the results, the maximum value for Cooks' Distance was .163, so these cases were retained in the data.

In addition, outliers for a dependent variable were analyzed with respect to a standardized residual scatterplot. The minimum standardized residual value was -2.845, and the maximum standardized residual value was 3.310. Since these values are between -3.3 and 3.3 (Tabachnick & Fidell, 2007), there were no outliers on the dependent variable.

4.2.1.2.1.2 Multicollinearity

The bivariate correlations among the independent variables were calculated (See Table 4.5). All Pearson Correlation coefficients between independent variables were below 0.8, showing no multicollinearity. Moreover, Tolerance and VIF values are also calculated, as shown in Table 4.20. According to the results, Tolerance values are not below .10, and VIF values are below 10. Therefore there is no violation of the multicollinearity assumption.

Table 4.20 Correlations

		TSECM	TEXPER	JS	ITSA	ME	VE	VP	PES
Pearson Correlation	TSECM	1.000							
	TEXPER	-.111	1.000						
	TJS	.131	.39	1.000					
	ITSA	.207	.015	.039	1.000				
	ME	.388	-.134	.310	.061	1000			
	VE	.182	-.069	.341	.154	.523	1.000		
	VP	.206	-.021	.342	.150	.502	.767	1.000	
	PES	-.135	-.035	.086	.026	.090	.303	.323	1.000

Moreover, Tolerance and VIF values are also calculated in Table 4.21. According to the results, Tolerance values are not below .10, and VIF values are below 10. Therefore there is no violation of the multicollinearity assumption.

Table 4.21 Collinearity Statistics

Independent Variables	Tolerance	VIF
TEXPER	.869	1.151
TJS	.741	1.350
ITSA	.967	1.034
ME	.658	1.520
VE	.376	2.661
VP	.358	2.793
PES	.874	1.144

4.2.1.2.1.3 Normality, Linearity, Homoscedasticity and Independence of Residuals

These assumptions were checked by examining standardized residual scatterplots. It was found that there is no violation of the normality, linearity, and homoscedasticity of residual assumptions (See Figure 4.5).

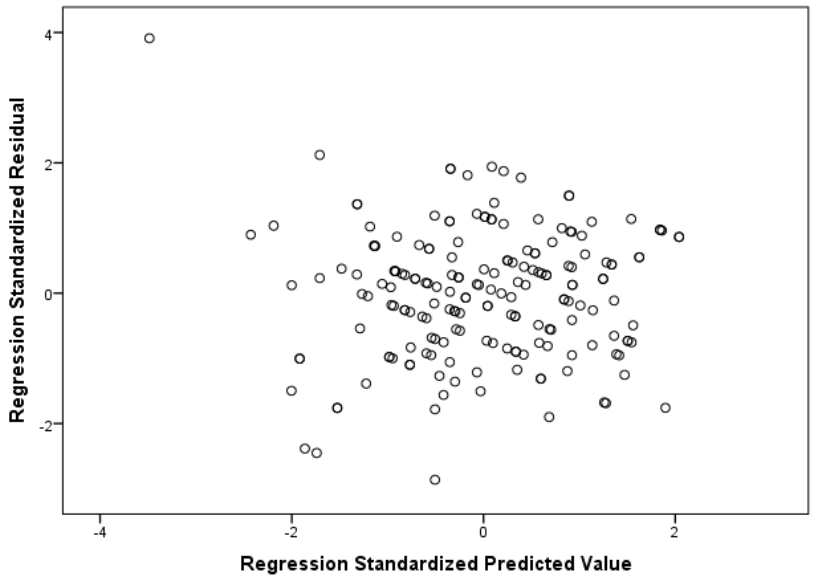

Figure 4.5. Scatterplot for Teacher Self-efficacy for Student Engagement

The independence of the residuals assumption was tested using the Durbin-Watson value, which should vary between 1.5 and 2.5, indicating satisfaction of the assumption. The Durbin-Watson value calculated as 1.96 demonstrated that there was no violation of the assumption (See Table 4.7).

4.2.1.2.2 Evaluating Model

Multiple linear regression analyses showed that the combination of the predictor variables was significantly related to the dependent variable F (7, 184) = 7.57, p <.017. The sample multiple correlation coefficient was .47, indicating that approximately 22.4 % of the variance of teacher self-efficacy for student engagement can be explained by the combination of independent variables (See Table 4.22).

Table 4.22 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.473	.224	.194	.93725	1,.959

More specifically, as seen in Table 4.23, it was found that mastery experience variable (beta= .36, sr square = .086, p<.017) explaining 8.6 % of variance uniquely made the strongest statistically significant contribution to the prediction of teaching self-efficacy for student engagement when the other variables controlled for. Moreover, physiological and emotional states (beta= -.19, sr square = .030, p<.017) explaining 3 % of variance uniquely and implicit theory of science ability (beta= .18, sr square = .033, p<.017) explaining 3.3 % of variance uniquely made also a statistically significant contribution to the prediction of in-service science teachers' teaching self-efficacy for student engagement. Whereas years of experience, job satisfaction, vicarious experiences, and verbal persuasions failed to achieve statistically significant contribution (p> .017).

Table 4.23 Coefficients

Independent Variables	Beta	Sig.	sr^2
Year	-.082	.244	.005
JS	.027	.721	.000
ITSA	.184	.006	.033
ME	.360	.000	.085
VE	-.062	.556	.001
VP	.094	.387	.003
PES	-.189	.007	.030

4.2.1.3 Results of Research Question 1.1: Teacher Self-efficacy for Instructional Strategies

1.3. How well do the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) predict in-service science teachers' teaching self-efficacy for instructional strategies?

Ho 1.3: There is no significant contribution of the proposed sources of teacher self-efficacy (i.e. years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological states) in the prediction of in-service science teachers' teaching self-efficacy for instructional strategies.

The dependent variable for the question was teaching self-efficacy for instructional strategies and the independent variables were years of experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states.

4.2.1.3.1 Assumptions of Reseach Question 1.3

4.2.1.3.1.1 Outliers

Multivariate outliers were detected via Mahallanobis' distance outlier screening procedure. The critical chi-square at alpha=.001 for "7" df is 24.32 (Tabachnick & Fidell, 2007). According to the results, Mahallanobis' distance value was 25.90. Therefore, five cases exceeding the critical value of 24.32 were determined as potential outliers. However, according to Tabachnick and Fidell (2007), cases with Cooks' distance values less than 1 are not influential on the regression equation. The maximum value for Cooks' Distance found as .178 suggested no need to remove these cases.

In addition, outliers for a dependent variable were analyzed with respect to a standardized residual scatterplot. The minimum standardized residual value was -2.710, and the maximum standardized residual value was 3.240. Since these values are between -3.3 and 3.3 (Tabachnick & Fidell, 2007), there were no outliers on the dependent variable.

4.2.1.3.1.2 Multicollinearity

The bivariate correlations among the independent variables were calculated (See Table 4.24). All Pearson Correlation coefficients were below 0.8, showing no multicollinearity. Multicollinearity assumptions were checked through the bivariate correlations among the independent variables (See Table 4.25). All Pearson Correlation coefficients between independent variables were below 0.8, showing no multicollinearity. Moreover, Tolerance and VIF values are also calculated, as shown in Table 4.10. According to the results, Tolerance values are not below .10, and VIF values are below 10. Therefore there is no violation of the multicollinearity assumption.

Table 4.24 Correlations

		TSEIS	TEXPER	JS	ITSA	ME	VE	VP	PES
Pearson Correlation	TSEIS	1.000							
	TEXPER	-.111	1.000						
	TJS	.068	.039	1.000					
	ITSA	.232	.015	.039	1.000				
	ME	.355	-.134	.310	.061	1.000			
	VE	.054	-.069	.341	.154	.523	1.000		
	VP	.148	-.021	.342	.150	.502	.767	1.000	
	PES	-.186	-.035	.086	.026	.090	.303	.323	1.000

Table 4.25 Collinearity Statistics

Independent Variables	Tolerance	VIF
TEXPER	.869	1.151
TJS	.741	1.350
ITSA	.967	1.034
ME	.658	1.520
VE	.376	2.661
VP	.358	2.793
PES	.874	1.144

4.2.1.3.1.3 Normality, Linearity, Homoscedasticity and Independence of Residuals

These assumptions were controlled by analyzing standardized residual scatterplots.It was found that there is no violation of the normality, linearity, and homoscedasticity of residual assumptions (See Figure 4.3).

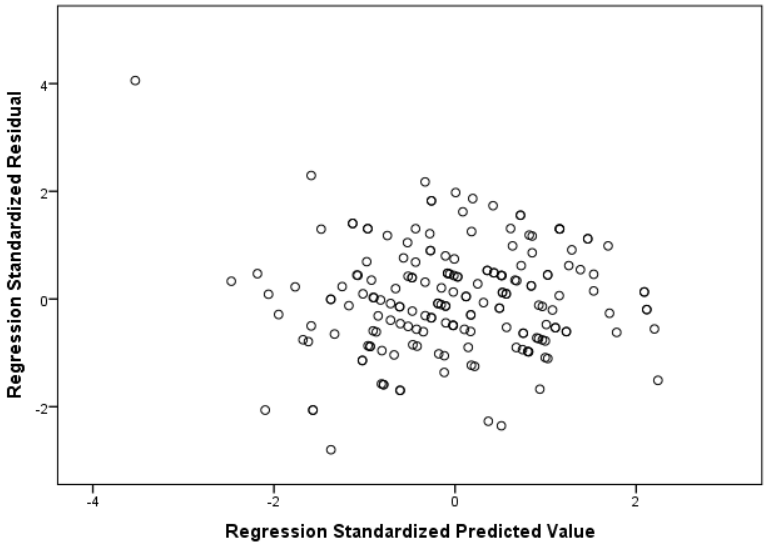

Figure 4.6. Scatterplot for Teacher Self-efficacy for Instructional Strategies

The independence of the residuals assumption was tested by using the Durbin-Watson value, which should vary between 1.5 and 2.5. The Durbin-Watson value calculated as 1.64 demonstrated that there was no violation of the assumption (See Table 4.26).

4.2.1.3.2 Evaluating the Model

Multiple linear regression analyses results showed that the combination of the predictor variables was significantly related to the dependent variable F (7, 184) = 9.128, p <.017. The sample multiple correlation coefficient was .51, indicating that approximately 25.8 % of the variance of teacher self-efficacy for instructional strategies can be explained by the combination of independent variables (See Table 4.26).

Table 4.26 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.507[a]	.258	.230	.82118	1.640

More specifically, as seen in Table 4.27, it was found that mastery experience variable (beta= .41, sr square = .108, p <.017) explaining 10.8 % of variance uniquely made the strongest statistically significant contribution to the prediction of teacheing self-efficacy for instructional strategies when the other variables controlled for. Moreover, implicit theory of science ability variable (beta= .23, sr square = .050, p <.017) predicting 5.2 % of variance uniquely, vicarious experiences variable (beta= -.28, sr square = .031, p <.017) predicting 3.1 % of variance uniquely, and physiological and emotional states (beta= -.21, sr square = .038, p <.017) explaining 3.8 % of variance uniquely made also a statistically significant contribution to the prediction of in-service science teachers' teaching self-efficacy for student engagement. Whereas years of experience, job satisfaction, and verbal persuasions failed to achieve a statistically significant contribution to the prediction of teacher self-efficacy for instructional strategies (p > .017).

Table 4.27 Coefficients

Independent Variables	Beta	Sig.	sr^2
TEXPER	-.071	.297	.004
TJS	-.042	.573	.001
ITSA	.231	.000	.052
ME	.406	.000	.108
VE	-.287	.006	.031
VP	.212	.047	.016
PES	-.209	.002	.038

4.2.2 Results of Research Question 2: Teacher Self-efficacy and its Consequence

Multiple regression analyses were conducted in this part of the study to provide solutions for the second research question related to science teachers' sense of self-efficacy and its consequence.

2. How well do in-service science teachers' teaching self-efficacy for classroom management, student engagement, and instructional strategies predict their mental model regarding their teaching beliefs ?

Ho 2: There is no significant contribution of the teachers' teaching self-efficacy for classroom management, teacher self-efficacy for student engagement, and teacher teacher self-efficacy for instructional strategies in the prediction of in-service science teachers' mental model regarding their teaching beliefs.

The dependent variable for the question was the mental model regarding science teachers' teaching beliefs. The independent variables were teacher self-efficacy for classroom management, teaching self-efficacy for student engagement, and teacher self-efficacy for instructional strategies.

4.2.2.1 Assumptions of Reseach Question 2

4.2.2.1.1 Sample Size

The sample size was calculated using N > 50 + 8.k (Tabachnick & Fidell, 2007). In this formula, k represents the number of independent variable numbers. The first research question has three independent variables, and so the number of participants should be a minimum of 74. Since the number of participant teachers who attended the study was 192, the sample size was enough to conduct multiple regression analysis..

4.2.2.1.2 Outliers

Multivariate outliers were detected via Mahallanobis' distance outlier screening procedure. The critical chi-square at alpha=.001 for "3" df is 16.27 (Tabachnick & Fidell, 2007). Since the Mahallanobis' distance value is 16.06, no cases exceed the critical value. In addition, outliers for a dependent variable were analyzed with respect to a standardized residual scatterplot. The minimum standardized residual value was -2.294, and the maximum standardized residual value was 1.837. Since these values are between -3.3 and 3.3 (Tabachnick & Fidell, 2007), there were no outliers on the dependent variable, teaching belief.

4.2.2.1.3 Multicollinearity

The bivariate correlations among the independent variables were calculated (See Table 4.28). All Pearson Correlation coefficients between independent variables were below 0.8, showing that there was no multicollinearity. Moreover, Tolerance and VIF values are also calculated in Table 4.11. According to the results, Tolerance values are not below .10, and VIF values are below 10. Therefore there is no violation of the multicollinearity assumption..

Table 4.28 Correlations

		TMENTAL	TSECM	TSESE	TSEIS
Pearson Correlation	TMENTAL	1.000	-.23	-.240	-.221
	TSECM	-.123	1.000	.725	.720
	TSESE	-.240	.725	1.000	.793
	TSEIS	-.221	.720	.793	1.000

Table 4.29 Collinearity Statistics

Independent Variables	Tolerance	VIF
TSECM	.418	2.391
TSESE	.322	3.106
TSEIS	.327	3.059

4.2.2.1.4 Normality, Linearity, Homoscedasticity and Independence of Residuals

These assumptions were checked by examining standardized residual scatterplots. It was found that there was no violation of the normality, linearity, and homoscedasticity of residual assumptions (See Figure 4.4).

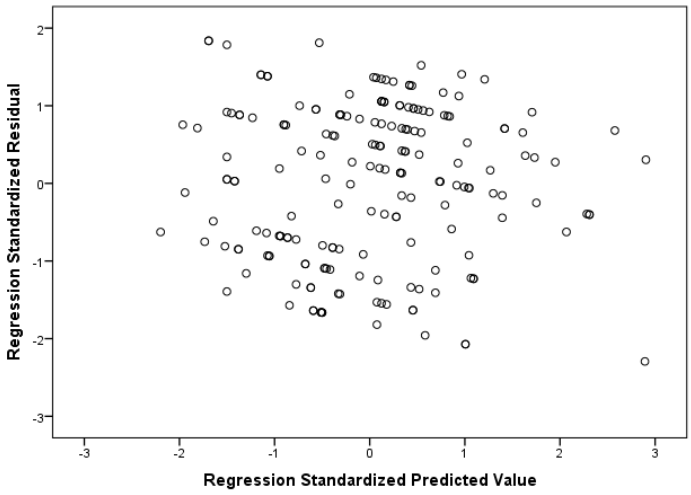

Figure 4.7. Scatterplot for Teaching Belief

In order to check the independence of the residuals assumption, the Durbin-Watson value was calculated. The values between 1.5 and 2.5 indicate satisfaction with the assumption. Accordingly, the Durbin-Watson value found as 1.68 demonstrated that there was no violation of the assumption.

4.2.2.2 Evaluating Model

Multiple linear regression analyses results showed that the combination of the predictor variables was significantly related to the dependent variable F (3, 188) = 4.66, p <.05. The sample multiple correlation coefficient was .26, indicating that approximately 6.9 % of the variance of teaching belief can be explained by the combination of independent variables (See Table 4.30).

Table 4.30 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.263[a]	.069	.054	3.46128	1,681

As seen in Table 4.31, it was found that none of the variables are statistically significant. More specifically, although its contribution was non-significant, teachers' self-efficacy for classroom management (beta= -.24, sr square = .094, p<.05) uniquely explained 1.7 % of the variance in the dependent variable. On the other hand, teachers' self-efficacy for student engagement (beta= .15, sr square= .009, p<.05) accounted for 0.9 % of the variance uniquely. Teachers' self-efficacy for instructional strategies (beta=-.14, sr square = .006, p<.05) explained 0.6 % of variance uniquely; however, these results were not statistically significant.

Table 4.31 Coefficients

Independent Variables	Beta	Sig.	sr^2
TSECM	.149	.173	.009
TSESE	-.235	.060	.017
TSEIS	-.142	.250	.006

4.2.3 Results of Research Question 3: Teacher Self-efficacy and Teaching Styles

In this part of the study, the multivariate analysis of variance (MANOVA) was conducted to provide solutions for the third research question related to science teachers' sense of self-efficacy and their teaching style..

3. Does in-service science teachers' teaching self-efficacy differ with respect to their mental models regarding their teaching style?

Ho 3: There is no difference between science teachers' teaching self-efficacy with respect to their teaching styles regarding exploratory, conceptual, and explicit.

The dependent variables for the question were teacher self-efficacy for classroom management, teaching self-efficacy for student engagement, and teacher self-efficacy for instructional strategies. The independent variable was teaching style regarding exploratory, conceptual, and explicit.

4.2.3.1 Assumptions of Reseach Question 3

4.2.3.1.1 Sample Size

It is necessary to have more cases in each cell than dependent variables (Pallant, 2001). For research question number three, there are nine cells regarding three levels of independent variables and three dependent variables. Therefore, there was no violation of the sample size assumption.

4.2.3.1.2 Outliers And Normality

Univariate outliers for each dependent variable were tested using skewness and kurtosis values (See Table 4.32). As the table shows, skewness and kurtosis values are vary between acceptable values -1 and 1 (Pallant, 2001).

Table 4.32 Descriptive Statistics for Teacher Self-Efficacy Subdimensions

	Exploratory		Conceptual		Explicit	
	Skewness	Kurtosis	Skewness	Kurtosis	Skewness	Kurtosis
TSECM	-.42	-.19	.05	-.83	.08	-.51
TSESE	-.07	.65	.23	-.69	-.25	.25
TSEIS	-.28	.05	-.19	.05	.37	.22

Multivariate outliers and multivariate normality were tested by using Mahallanobis' distance outlier screening procedure. The critical chi-square at alpha=.001 for "3" df is 16.27 (Tabachnick & Fidell, 2007). Since Mahallanobis' distance value is 16.065, no cases exceed the critical value. Moreover, normality is checked by the histograms, and it was observed that the scores were normally distributed.

4.2.3.1.3 Linearity

Linearity assumption means a straight-line relationship between each pair of dependent variables is tested by generating a matrix of scatterplots. As seen in Figure 4.8, the plots do not show any obvious evidence of non-linearity; therefore linearity assumption is satisfied.

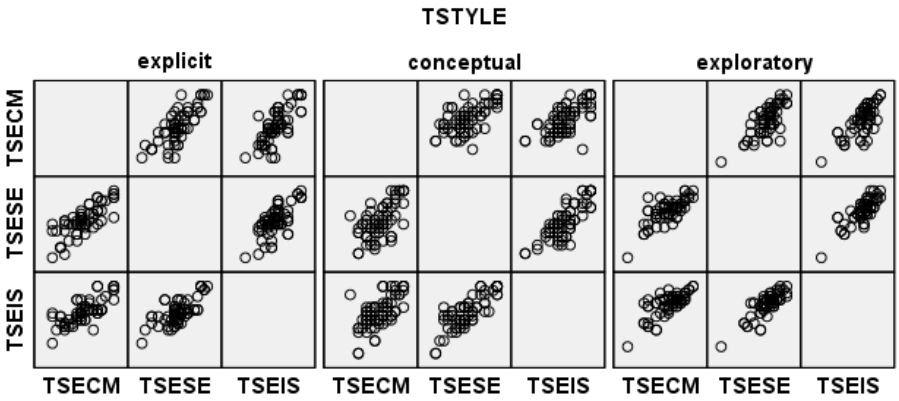

Figure 4.8. The Matrix Scatterplots for Teacher Self-efficacy Subdimensions

4.2.3.1.4 Multicollinearity and Singularity

Multicollinearity and singularity assumptions were checked by calculating the bivariate correlations among the dependent variables (See Table 4.33). All Pearson Correlation coefficients were below 0.8 as suggested by (Pallant, 2001), which shows that there was no violation for multicollinearity assumption.

Table 4.33 Correlation

		TSECM	TSESE	TSEIS
Pearson Correlation	TSECM	1.00		
	TSESE	.73**	1.00	
	TSEIS	.72**	.79**	1.00

**. Correlation is significant at the 0.01 level (2-tailed).

4.2.3.1.5 Homogeneity of Variance-Covariance Matrices

Homogeneity of Variance-Covariance Matrices assumption was analyzed via Box's M Test of Equality of Covariance Matrices. Results showed that Box's M significance value is .114, which should be larger than .001 as suggested by Tabachnick and Fidell (2007) (See Table 4.34). Therefore, there is no violation for homogeneity of variance-covariance matrices assumption.

Table 4.34 Box's Test of Equality of Covariance Matrices

Box's M	18.486
F	1.505
df1	12
df2	170841.075
Sig.	.114

In addition to this, Levene's Test of Equality of Error Variances results, Table 4.14, were also examined homogeneity of variance assumption. Results showed no violation since *p* values are not less than .05, as suggested by Tabachnick and Fidell (2007).

Table 4.35 Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
TSECM	.704	2	189	.496
TSESE	1.237	2	189	.293
TSEIS	.522	2	189	.594

4.2.3.2 Evaluating Model

A multivariate analysis of variance was performed to investigate teaching styles differences in teachers' self-efficacy. Three dependent variables were used: teacher self-efficacy for classroom management, teacher self-efficacy for student engagement, and teacher self-efficacy for instructional strategies. The independent variable was teaching styles regarding exploratory, conceptual, and explicit. Preliminary assumption testing was conducted to address normality, linearity, univariate and multivariate outliers, multicollinearity, and homogeneity of variance-covariance matrices with no serious violations noted. As shown in Table 4.36, there was a statistically significant difference between teaching styles on the combined dependent variables, F (6, 374) = 3.52 , p = .002 , Wilks' Lambda = .89 ; partial eta squared = .054.

Table 4.36 Results of MANOVA

Effect	Wilks' Lambda Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
TSTYLE	.896	3.527	6.000	374.000	.002	.054

Moreover, when the results for dependent variables were considered separetly, by using a Bonferroni adjusted alpha level of .017, there was statistically significant difference for teachers' teaching self-efficacy for student engagement F (2, 189) =

6.95, $p = .001$, partial eta squared = .07; and for teacher self-efficay for instructional strategies F (2, 189) = 5.37, $p = .005$, partial eta squared = .05 (See Table 4.37).

Table 4.37 Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
TSTYLE	TSECM	5.796	2	2.898	3.557	.030	.036
	TSESE	14.267	2	7.134	6.950	.001	.069
	TSEIS	8.993	2	4.496	5.376	.005	.054

As seen in Table 4.38, Post-hoc comparisons using the Scheffe Test indicated that the teachers with exploratory teaching style (M = 7.48, SD = .90) had significantly higher levels of teacher self-efficacy for student engagement compared to the teachers with explicit teaching style (M = 6.81, SD = 1.09). Similarly, the teachers with exploratory teaching style (M = 7.64, SD = .87) were found to have significantly higher levels of teacher self-efficacy for instructional strategies compared to the teachers with explicit teaching style (M = 7.12, SD = 0.91). Concerning self-efficacy for classroom management, no significant difference was found between the teachers with exploratory teaching style (M = 7.46, SD = .87), conceptual teaching style (M =7.57, SD = .83), and explict teaching style (M = 7.16, SD = 1.00).

Table 4.38 Multiple Comparisions

Scheffe

Dependent Variable	(I) mental model	(J) mental model	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
classroom management	exploratory	conceptual	-.1040	.15973	.809	-.4982	.2901
		explicit	.3030	.16151	.175	-.0955	.7014
	conceptual	exploratory	.1040	.15973	.809	-.2901	.4982
		explicit	.4070*	.15776	.038	.0178	.7962
	explicit	exploratory	-.3030	.16151	.175	-.7014	.0955
		conceptual	-.4070*	.15776	.038	-.7962	-.0178
student engagement	exploratory	conceptual	.2743	.17929	.313	-.1681	.7167
		explicit	.6709*	.18129	**.001**	.2236	1.1182
	conceptual	exploratory	-.2743	.17929	.313	-.7167	.1681
		explicit	.3966	.17708	.084	-.0403	.8335
	explicit	exploratory	-.6709*	.18129	.001	-1.1182	-.2236
		conceptual	-.3966	.17708	.084	-.8335	.0403
instructional strategies	exploratory	conceptual	.1808	.16185	.537	-.2186	.5801
		explicit	.5263*	.16365	.007	.1225	.9300
	conceptual	exploratory	-.1808	.16185	.537	-.5801	.2186
		explicit	.3455	.15985	.100	-.0489	.7399
	explicit	exploratory	-.5263*	.16365	**.007**	-.9300	-.1225
		conceptual	-.3455	.15985	.100	-.7399	.0489

CHAPTER 5

CONCLUSIONS, DISCUSSIONS, AND IMPLICATIONS

This chapter includes the summary of the research study, conclusions, discussion, and implications of the results, and also the last section presents recommendations for further research.

5.1 Summary of the Research

In the present study, the main purpose was to investigate the sources and consequence of middle school in-service science teachers' teaching self-efficacy. In line with the aims of the research study, 192 in-service science teachers chosen from the accessible population in Çankaya and Gölbaşı district of Ankara were administered the Teacher Sense of Efficacy Scale (TSES), Teacher Job Satisfaction Scale (TJSS), Implicit Theory of Science Ability Scale (ITSA), Sources of Self-efficacy Inventory (SOSI), and the Draw a Science Teacher Test-Checklist (DASST-C). In order to investigate how well the proposed sources predicted teachers' teaching self-efficacy, three different multiple regression analyses for each subscale of the TSES were conducted. Additionally, to reveal how well teachers' teaching self-efficacy predicts the consequence, one more multiple regression analysis was carried out. As sources of teaching self-efficacy, years of teaching experience, job satisfaction, implicit theory of science ability, and Bandura's hypothesized sources were specified. On the other hand, teachers' mental models regarding their teaching beliefs were identified as a consequence of teacher self-efficacy. Moreover, the study extended by conducting multivariate analysis of variance (MANOVA) to examine whether teachers' teaching self-efficacy beliefs differ concerning their teaching styles, determined through their mental models.

5.2 Discussions of the Results

This study firstly investigated the research question of how well proposed sources of teaching self-efficacy, i.e., years of teaching experience, job satisfaction, implicit theory of science ability, mastery experience, vicarious experience, verbal persuasion, and physiological and emotional states, predicts in-service science teachers' teaching self-efficacy in three sub-dimensions, namely student engagement, instructional strategies, and classroom management. Concerning in-service science teachers' teaching self-efficacy for student engagement sub-dimension, results of multiple regression analysis revealed that mastery experience (β = .37), physiological and emotional states (β = -. 24), and implicit theory of science ability (β = .21) were significantly related to science teachers' teaching self-efficacy for student engagement. More specifically, it was found that in-service science teachers' mastery experiences positively predicted their self-efficacy for student engagement. In other words, as in-service science teachers' mastery experience increases, their teaching self-efficacy for student engagement also increases. However, physiological and emotional states negatively predicted science teachers' self-efficacy for student engagement. This means that, as in-service science teachers' anxiety, fear, or tension increase during class hours, their self-efficacy for student engagement is more likely to decrease. In a similar context, Kıran (2021) also found that mastery experience was the most powerful source of teaching self-efficacy for student engagement, while physiological and emotional states were a negative predictor. Additionally, in the presents study, teachers' implicit theories of science ability was found to be a positive predictor of their self-efficacy for student engagement implying that the teachers with the belief that students' science ability is not fixed tend to have higher self-efficacy for student engagement. This result is consistent with the literature findings; for example, Palazzolo (2016) found a significant positive relationship between high-level teacher self-efficacy for student engagement and an incremental view of science ability. On the other hand, in the present study, vicarious experience, verbal persuasion, job satisfaction, and years of

teaching experience were not found as significant predictors of teacher self-efficacy for student engagement.

The same results were obtained for the self-efficacy for classroom management sub-dimension. More specifically, multiple regression results also indicated that mastery experience (β = .36) and implicit theory of science ability (β = .18) were significant positive predictors, whereas physiological and emotional states (β = -.19) were significant negative predictor of teaching self-efficacy for classroom management. These results were also consistent with the findings in the related literature (Hoy & Spero, 2005; Kıran, 2021; Klassen & Chiu, 2010; Palazzolo, 2016; Palmer, 2006; Tchannen-Moran & Hoy, 2007).

Regarding self-efficacy for instructional strategies sub-dimension, results were also similar. Specifically, consistent with the findings for other sub-dimensions mastery experience (β = .41) and implicit theory of science ability (β = .23) were found as significant positive predictors. However, for this dimension, not only physiological and emotional states (β =- .21) but also vicarious experience (β = -.28) was found as a negative predictor The negative relation found between vicarious experience and self-efficacy for instructional strategies imply that as the model teacher performs well, the participant teachers' teaching self-efficacy instructional strategies decreases. Although many researchers found the vicarious experience as a positive predictor of teaching self-efficacy, Bandura (1997) stated that vicarious experience could enhance or decrease teaching self-efficacy. There are studies in the literature supporting the current finding that vicarious experience decreases teaching self-efficacy (Paulou, 2007; Sahranç, 2007). According to the relevant literature, school-level variables such as school atmosphere and structure can also influence teachers' teaching self-efficacy beliefs. For example, it was found that teachers who perceived the school climate positively had stronger teaching self-efficacy beliefs (Moore & Esselman, 1992). It was also stated that receiving positive feedback on teacher

performance and collaboration with other teachers were significantly associated with teachers' teaching self-efficacy (Rosenholtz, 1989). Accordingly it is thought that there is a need for a detailed examination of school culture and the communication of teachers with each other in the schools where the research was conducted. If cooperation between teachers is not sufficiently supported in schools and there is a competitive environment, a teacher's practices that can be exemplary in terms of instructional strategies may put pressure on other teachers. As a result, there may be a decrease in their teaching self-efficacy for instructional strategies. However, this possible explanation for the negative relationship between vicarious experience and teaching self-efficacy for instructional strategies is speculative and warrants further investigation.

Overall, results for Banduras' hypothesized four sources indicate that mastery experience made the largest contribution to predicting teachers' teaching self-efficacy for all subdimensions. This result is consistent with the related literature, which emphasizes that mastery experience is the strongest predictor of self-efficacy beliefs for in-service teachers as it is for preservice teachers and students (Bandura, 1997; Hoy & Spero, 2005; Kıran, 2021; Klassen & Chiu, 2010; Mohamadi & Asadzadeh, 2012; Palmer, 2006; Tchannen-Moran & Hoy, 2007). Physiological and emotional states negatively predicted participant teachers' teaching self-efficacy for all subdimensions. This result is also consistent with the related literature (Caprara et al., 2013, O' Neil & Stephenson 2012, Sahranç 2007). On the other hand, in the present study, verbal persuasion was not found as a statistically significant predictor for any teaching self-efficacy sub-dimension. This result is also consistent with literature (Kaçar & Beycioğlu, 2017; Rubble et al., 2011; Tchannen-Moran & Hoy, 2007). Moreover, Kıran (2021) could not find the contribution of verbal persuasion prediction to teaching self-efficacy except for one sub-dimension: classroom management. This result means that in-service science teachers appear not to develop their teacher efficacy from verbal judgments about their profession from their colleagues, family, and students. This result could be expected since Bandura (1997)

stated that verbal persuasion source is the least effective regarding the strength of the persuasion. Lastly, vicarious experience source was not found as a statistically significant predictor of teaching self-efficacy for classroom management and student engagement subdimensions. According to the literature teachers can develop their self-efficacy through vicarious experience, mainly when they have limited past experience (Bandura, 1997; Mohamadi & Asadzadeh, 2011; Schunk, 2004). Moreover, Tchannen-Moran and Hoy (2007) stated that among Bandura's hypothesized sources, verbal persuasion and vicarious experience might be the most salient predictors of teaching self-efficacy for pre-service and novice teachers who have lack significant mastery experience rather than experienced teachers.In the present study, most of the participants were experienced teachers with more than five years of teaching experience. Thus, based on the aforementioned literature, it is an expected finding that vicarious experience is not a significant predictor of teaching self-efficacy.

In addition, the implicit theory of science ability was found to be positively and significantly related to all sub-dimensions of teaching self-efficacy. This result indicated that the teachers believing that individuals' science ability is flexible tend to have a higher level of self-efficacy. These results were consistent with the findings in the relevant literature (Deemer 2004, Lee 1996, Palazzola, 2016; Sarazzin et al., 2007; Tamir et al. 2007, Yerdelen 2013). For example, For example, in a similar context, McWilliams (2012) examined the relationship between teachers' implicit theories and teaching self-efficacy. McWilliams (2012) found that as teachers' tendency to incremental theory increases, their teaching self-efficacy enhances. Feldstein (2017) also found that novice teachers' implicit theories and teaching self-efficacy are highly correlated, and this correlation influences their intention to remain in the profession. According to the relevant literature, teachers' teaching self-efficacy and implicit ability beliefs play an important role in their classroom practices. For example, Tamir et al. (2007) stated that teachers with incremental theory and high teaching self-efficacy for student engagement are more likely to

encourage student participation and efforts, praise their students' progress, and appraise them via multiple approaches. These teachers with high-level teaching self-efficacy for classroom management tend to spend their time helping their students, controlling their disruptive behaviors, establishing classroom rules, and encouraging them to follow these rules (Deemer, 2004). Lee (1996) stated that incremental teachers with a high teaching self-efficacy for instructional strategies tend to effort-oriented feedback and learning assignments to enhance students' competence, skills, and abilities.

On the other hand, teachers' years of experience was not a significant predictor of any teaching self-efficacy sub-dimension. Regarding teachers' years of experience, the relevant literature implies mostly inconsistent results. In other words, for example, some researchers found a non-linear relationship between teachers' years of experience and all three self-efficacy dimensions, rising from the beginning of the career to mid-career and decreasing afterward (Klassen & Chiu, 2010; Soodak & Podell, 1997; Woolfolk Hoy & Burke Spero, 2005). In another study conducted by Tschannen-Moran and Woolfolk Hoy, 2001), teachers' years of teaching have moderate effects on teaching self-efficacy for instructional strategies and classroom management, but no effect on teacher self-efficacy for student engagement. Other researchers stated that teaching self-efficacy was positively related to years of teaching experience (Hoy & Woolfolk, 1993; Campbell, 1996). However, the present study results indicate that the years of teaching experience were a non-significant predictor of teachers' teaching self-efficacy across its three sub-dimensions. Nevertheless, there are studies in the literature supporting this finding (Cheung, 2007; Ross et al., 1996; Tschannen-Moran & Johnson, 2011; Wolters & Dougherty, 2007). Moreover, Bandura (1997) asserted that self-efficacy beliefs are most in flux early in teaching and tend to become relatively stable and resist change once set. Tschannen-Moran and Hoy (2007) induced that although it might seem like years of teaching experience would predict teaching self-efficacy if self-efficacy

tends to resist change once set, then teaching self-efficacy would not be willing to enhance as years of teaching experience increase.

In addition to years of teaching experience, job satisfaction was also a non-significant predictor of teaching self-efficacy for all sub-dimensions. In a similar context with the current study, Demirdag (2015) also found no relationship between overall job satisfaction and teacher self-efficacy. However, when the literature was reviewed, in general, this result was not consistent with the previous findings, which demonstrated a positive relationship between job satisfaction and self-efficacy (Klassen & Chiu, 2010, Turkoglu et al., 2017). For example, Turkoglu et al. (2017) conducted a study with elementary, middle, and high school teachers, and the result revealed that job satisfaction was found as a significant predictor for teacher self-efficacy. Actually, job satisfaction has often been regarded as a decisive factor for improving teachers' motivation and performance. According to Caprara et al. (2006), teachers' most significant source of teaching self-efficacy and teachers' mastery experiences are fostered by their successful past experiences. Teachers' positive past experiences may increase their job satisfaction by offering internal and external rewards, which in turn, improve their teaching self-efficacy. This procedure would be consistent with the social-cognitive theory (Bandura, 1997), which suggests that positive affective factors such as job satisfaction can be a source of teaching self-efficacy. Therefore, the current study results expected job satisfaction as a positive predictor of teaching self-efficacy, but the results did not support it. However, at this point it is important to note that, in this study, the direct association between teaching self-efficacy and job satisfaction was analyzed. However, there might be mediator or moderator factors which enable that relationship. For example, job stress, caused by inadequate working conditions, limited time to prepare for the lesson, working hours, is a mediator between teaching self-self-efficacy and job satisfaction (Troesch & Bauer, 2017). Further studies should also consider moderator factors which affect the proposed association.

In sum, results for the first question indicate that mastery experience was the most significant predictor, implicit theory of science ability was the second significant positive predictor, and physiological and emotional states was a significant negative predictor of in-service science teachers' teaching self-efficacy. Among the proposed sources of teaching self-efficacy, job satisfaction, years of teaching experience, and verbal persuasion were not statistically significant predictors. According to the relevant literature, the lack of these proposed sources as a predictor of teaching self-efficacy among experienced teachers might indicate that with the accumulation of mastery experiences, other sources play a less significant role in developing teaching self-efficacy (Tschannen-Moran & Hoy, 2007). In other words, mastery experience source would play a more prominent role in forming teachers' teaching self-efficacy belief since it was the most powerful predictor. On the other hand, other sources would be more salient for novice teachers who have less than five years of teaching experience because they have few past experiences (Tschannen-Moran & Hoy, 2007). Therefore, the current study results could be concluded as expected results along with the literature since participants were mostly experienced teachers rather than novice teachers.

Secondly, this study also investigated the relationship between teachers' teaching self-efficacy and its consequence. As a consequence, in-service science teachers' mental models regarding their teaching beliefs in terms of teacher-centered or student-centered were examined. Multiple regression analyses were conducted, and results indicated that the combination of teaching self-efficacy subdimensions was significantly related to middle school science teachers' teaching beliefs. However, unique contributions of each sub-dimension, namely teaching self-efficacy for classroom management, teaching self-efficacy for student engagement, and teaching self-efficacy for instructional strategies subdimensions were not statistically significant. Although in this study, teachers' teaching self-efficacy subdimensions were not found as significant predictors of teachers' mental models regarding their teaching beliefs, in the relevant literature, some studies found significant relationship

(Finson et al., 2006; Tartar et al., 2012; Thomas et al., 2001). The current findings may suggest that, apart from the existent predictors, there might other variables that explain teachers' mental models regarding their teaching beliefs. Future studies may take this suggestion into consideration; for example, the direct relations of the variables used as sources of teaching self-efficacy in the present study with the teachers' mental models regarding their teaching beliefs can be analyzed.

Lastly, the current study examined whether in-service science teachers' mental models regarding their teaching styles, namely exploratory, conceptual, and explicit, differ with respect to their teaching self-efficacy for classroom management, student engagement, and instructional strategies sub-dimensions. According to multivariate test analysis (MANOVA), there was a significant difference between in-service science teachers teaching styles with respect to the combination of teacher self-efficacy subdimensions. Moreover, inservice science teachers' teaching self-efficacy for student engagement and also for instructional strategies differ with respect to their teaching styles. Indeed, teachers with exploratory teaching styles tend to have higher teaching self-efficacy for student engagement and instructional strategies than teachers with explicit teaching styles. In other words, teachers with exploratory teaching styles have a high capability to engage students in science education and apply appropriate instructional strategies compared to teachers with explicitly teaching styles. Moreover, according to DASST- C developers Thomas et al. (2001), teachers with exploratory teaching styles are more likely to apply student-centered teaching strategies, whereas teachers with explicit teaching styles tend to apply teacher-centered teaching methods. Additionally, teachers with exploratory teaching styles tend to engage students to investigate new concepts individually or in group work, improve students' problem solving, thinking, and innovation skills, and gain more attention to their students' choices in the classroom environment teacher mostly has guidance role. Thus, the current findings were as expected based on available literature (Finson et al., 2006; Finson et al., 2000; Rubeck & Enochs ,1990).

5.3 Implications of the study

The present study examined the relationship between sources and consequence of middle school in-service science teachers' teaching self-efficacy beliefs. In the light of the results of the current study, it can be inferred that in-service science teachers primarily utilize mastery experiences to develop their teaching self-efficacy as well as physiological and emotional states and implicit theory of science ability. Teaching self-efficacy begins to develop early in teaching careers and even takes its first steps during the preservice teaching period. In the literature, there are various studies examining the preservice teachers' teaching self-efficacy beliefs (Kıran, 2021). Therefore, since teacher self-efficacy beliefs are more malleable in preservice and early teaching years period (Hoy & Spero, 2005), it is suggested that teacher education programs may pay more attention to teaching internship courses where teacher candidates gain more direct experience. This application also offers advantages to inservice science teachers to review their own mastery experiences.

According to the results, the implicit theory of science ability was a significant predictor that contributes to developing teaching self-efficacy for student engagement, classroom management, and instructional strategies. In the school context, incremental teachers with a high level of self-efficacy can believe that students' science learning ability is malleable and so students can increase their knowledge. On the other hand, entity teachers with low teaching self-efficacy can believe that students' science ability is fixed and can not change it. It is important to note that having an incremental theory about students' abilities would provide positive school practices regarding instructional practices (Pintrich & Schunk, 2002). Therefore, it is suggested that school principles set a shared belief among all teachers that students can develop their abilities. Science teachers also may have high expectancy for all their students regarding their science ability.

Additionally, results also indicate that inservice science teachers, anxiety, fear, or tension increases, their teaching self-efficacy decreases. Therefore, teachers may attend a workshop on stress management. Knowing how to handle stress on the job help to raise teaching self-efficacy for teaching. In this way, teachers feel confident about controlling their physiological and emotional states and focus on classroom management, student engagement, and instruction.

Moreover, in-service science teachers also utilize vicarious experiences as a source of teaching self-efficacy for instructional strategies. Results indicate that participant teachers' self-efficacy for instructional strategies decreases as the model teachers perform well. In order to prevent this decrease, in-service science teachers may attend inservice training program courses developed by the Ministry of National Education General Directorate of Teacher Training and Development. These courses allow teachers from different schools to share their experiences about how and which instructional methods are applied in the learning environment. Moreover, these courses also allow the participants to work for an interdisciplinary team about the topics such as STEM education, flipped learning classroom applications, out-of-school learning, robotic coding, storytelling. In addition, the Ministry of National Education General Directorate of Teacher Training and Development also provides workshops and seminars including research-inquiry based science education, critical thinking, innovative thinking, collaboration and competencies development, activity based lesson plan design, stem applications in nature education, measurement and evaluation with innovative approaches. Teachers should update and improve their Professional competencies by participating in such training. Thus, teachers familiar with teacher-centered practices in their classrooms are encouraged to adopt exploratory teaching styles and increase their teaching efficacy beliefs for student engagement and instructional strategies in science education.

5.4 Recommondations for Further Research

As stated in the method chapter, there are some limitations that need to be addressed to take into account in future research. Firstly, the present study relied on self-report instruments to collect data. Although a drawing-based instrument could potentially discover teachers' mental beliefs, future studies can use qualitative data collection tools such as interviews with the teachers, observations, questioning about learning environments such as classrooms, laboratories, playgrounds to make deep investigations about teachers' teaching self-efficacy and its sources and consequence. Moreover, one of the sources of teaching efficacy was job satisfaction, and this variable was measured using the self-report methodology which is arguably the most appropriate method. However, future research may involve alternative ways to investigate this variable. For example, interviews can be conducted with principals and teachers to examine the relationship between job satisfaction and teaching self-efficacy deeply. In addition, potential moderator variables such as job stress (Buric & Kim, 2021) can be explored. In addition, the present study was based on cross-sectional data, and it does not provide a causal relationship. It is recommended to study longitudinal research design further to gain more evidence regarding the impact of the teachers' teaching self-efficacy on their teaching styles. Longitudinal study design would also allow observing the periods of flux and stability of the teaching self-efficacy at different career stages regarding preservice, novice, mid, and late-career. Further studies should involve contextual sources such as teaching resources and verbal persuasions, especially when the novice teacher participants constitute the main sample. Tschannen-Moran and Hoy (2007) stated that pre-service and novice teachers tend to be more affected by contextual sources.

Lastly, the data was collected from Çankaya and Gölbaşı district of Ankara province. Since the cultural and contextual factors might affect the sources of teaching self-efficacy, further research may collect data from the different provinces of Turkey to make sure about the inferences.

REFERENCES

Acisli, S. (2017). Investigation of mental models for science teaching and primary school teacher candidates' self- efficacy beliefs. New Trends and Issues Proceedings on Humanities and Social Sciences. [Online]. 01, pp 265-272.

Anderson, R. N., Greene, M. L., & Loewen, P. S. (1988). Relationships among teachers' and students' thinking skills, sense of efficacy, and student achievement. Alberta Journal of Educational Research.

Ambusaidi, A. K., & Al-Balushi, S. M. (2012). A Longitudinal Study to Identify Prospective Science Teachers' Beliefs about Science Teaching Using the Draw-a-Science-Teacher-Test Checklist. International Journal of Environmental and Science Education, 7(2), 291-311.

Allinder, R. M. (1994). The relationship between efficacy and the instructional practices of special education teachers and consultants. Teacher education and special education, 17(2), 86-95.

Ashton, P. T., & Webb, R. B. (1986). *Making a difference: Teachers' sense of efficacy and student achievement*. Longman Publishing Group.

Aydın, Y. Ç., & Uzuntiryaki, E. (2009). Development and psychometric evaluation of the high school chemistry self-efficacy scale. Educational and Psychological Measurement, 69(5), 868-880.

Baldwin, J. A., Ebert-May, D., & Burns, D. J. (1999). The development of a college biology self-efficacy instrument for nonmajors. *Science education*, *83*(4), 397-408.

Bandura, A. (1997). Self-efficacy: The exercise of control. New York, NY: W. H. Freeman.

Bandura, A., & Wood, R. (1989). Effect of perceived controllability and performance standards on self-regulation of complex decision making. Journal of personality and social psychology, 56(5), 805.

Bilican, K., Ozdem-Yılmaz, Y., & Oztekin, C. (2014). Tracking the Footprints of Nature of Science in the Path of Learning How to teach it. *Eurasia Journal of Mathematics, Science and Technology Education*, *10*(6), 595-608.

Borton, W. M. (1991). Empowering Teachers and Students in a Restructuring School: A Teacher Efficacy Interaction Model and the Effect on Reading Outcomes.

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *43*(5), 485-499.

Bruce, C. D., & Ross, J. A. (2008). A model for increasing reform implementation and teacher efficacy: Teacher peer coaching in grades 3 and 6 mathematics. *Canadian Journal of Education/Revue canadienne de l'éducation*, 346-370.

Buluç, B., & Demir, S. (2015). İlk ve ortaokul öğretmenlerinin öz-yeterlik algilari ile iş doyumlari arasindaki ilişki. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi*, *16*(1), 289-308.

Bullock, A., Coplan, R. J., & Bosacki, S. (2015). Exploring links between early childhood educators' psychological characteristics and classroom management self-efficacy beliefs. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *47*(2), 175.

Burić, I., & Kim, L. E. (2021). Job satisfaction predicts teacher self-efficacy and the association is invariant: Examinations using TALIS 2018 data and longitudinal Croatian data. Teaching and Teacher Education, 105, 103406.

Butz, A. R., & Usher, E. L. (2015). Salient sources of early adolescents' self-efficacy in two domains. *Contemporary Educational Psychology*, *42*, 49-61.

Cakiroglu, E. (2008). The teaching efficacy beliefs of pre-service teachers in the USA and Turkey. *Journal of Education for Teaching*, *34*(1), 33-44.

Can, H. (2015). Sources of Teaching Efficacy Beliefs in Pre-service Science Teachers. *Ilkogretim Online*, *14*(3).

Cansoy, R., Polatcan, M., & Parlar, H. (2018). Research on Teacher Self-Efficacy in Turkey: 2000-2017. *World Journal of Education*, *8*(4), 133-145.

Cantrell, P., Young, S., & Moore, A. (2003). Factors affecting science teaching efficacy of preservice elementary teachers. *Journal of Science Teacher Education*, *14*(3), 177-192.

Campbell, J. (1996). A Comparison of Teacher Efficacy for Pre and In-service Teachers in Scotland and America. Education, 117 (1), 2–11.

Capa-Aydin, Y., Uzuntiryaki-Kondakci, E., & Ceylandag, R. (2018). The relationship between vicarious experience, social persuasion, physiological state, and chemistry self-efficacy: The role of mastery experience as a mediator. *Psychology in the Schools*, *55*(10), 1224-1238.

Caprara, G. V., Barbaranelli, C., Borgogni, L., & Steca, P. (2003). Efficacy beliefs as determinants of teachers' job satisfaction. *Journal of educational psychology*, *95*(4), 821.

Caprara, G. V., Barbaranelli, C., Steca, P., & Malone, P. S. (2006). Teachers' self-efficacy beliefs as determinants of job satisfaction and students' academic achievement: A study at the school level. *Journal of school psychology*, *44*(6), 473-490.

Chambers, D. W. (1983). Stereotypic images of the scientist: The draw-a-scientist test. *Science education*, *67*(2), 255-265.

Chacón, C. T. (2005). Teachers' perceived efficacy among English as a foreign language teachers in middle schools in Venezuela. *Teaching and Teacher Education*, *21*(3), 257-272.

Chen, J. A., & Pajares, F. (2010). Implicit theories of ability of Grade 6 science students: Relation to epistemological beliefs and academic motivation and achievement in science. *Contemporary Educational Psychology*, *35*(1), 75-87.

Clark, S., & Newberry, M. (2019). Are we building preservice teacher self-efficacy? A large-scale study examining teacher education experiences. *Asia-Pacific Journal of Teacher Education*, *47*(1), 32-47.

Çapa, Y., Çakıroğlu, J., & Sarıkaya, H. (2005). Öğretmen özyeterlik ölçeği Türkçe uyarlamasının geçerlik ve güvenirlik çalışması. *Eğitim ve Bilim*, *30*(137).

Çapa Aydın, Y., Uzuntiryaki Kondakçı, E., Temli, Y. ve Tarkın, A. (2013). Özyeterlik Kaynakları Ölçeği'nin Türkçe'ye Uyarlanması. İlköğretim Online, 12 (3), 749-758.

Deemer, S. (2004). Classroom goal orientation in high school classrooms: Revealing links between teacher beliefs and classroom environments. *Educational research*, *46*(1), 73-90.

Demirdag, S. (2015). Assessing teacher self-efficacy and job satisfaction: Middle school teachers. *Journal of Educational and Instructional Studies in the World*, *5*(3), 35-43.

Demirtaş, Z. (2010). Okul kültürü ile öğrenci başarısı arasındaki ilişki. *Eğitim ve Bilim*, *35*(158).

Dinham, S. (1995). Time to focus on teacher satisfaction [Shorter version of a paper, Enhancing the Quality of Teacher Satisfaction, presented to the Australian College of Education. Conference. (1994: Launceston).]. *Unicorn (Carlton, Vic)*, *21*(3), 64-75.

Dinham, S., & Scott, C. (1998). A three domain model of teacher and school executive career satisfaction. *Journal of educational administration*.

Dweck, C. S. (1986). Motivational processes affecting learning. *American psychologist*, *41*(10), 1040.

Dweck, C. (1999). Self-theories: Impact on motivation, personality and development.

Dweck, C. S. (2002). The development of ability conceptions. *Development of achievement motivation*, 57-88.

Dweck, C., & Bempechat, J. (1983). Children's theories of intelligence: Consequences for learning. In S. G. Paris, G. M. Olson & H. W. Stevenson (Eds.), *Learning and motivation in the classroom* (pp. 239-256). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Dweck, C. S., & Henderson, V. L. (1989). Theories of Intelligence: Background and Measures.

Dweck, C. S., & Leggett, E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological review*, *95*(2), 256.

Elmas, R., Demirdöğen, B., & Geban, Ö. (2011). Preservice chemistry teachers' images about science teaching in their future classrooms. Hacettepe University Journal of Education, 40, 164-175.

Enochs, L. G., & Riggs, I. M. (1990). Further development of an elementary science teaching efficacy belief instrument: A preservice elementary scale.

Evans, T. V. (2001). *Verbal syntax in the Greek Pentateuch: Natural Greek usage and Hebrew interference*. Oxford University Press on Demand.

Feyzioğlu, E. Y., Feyzioğlu, B., & Küçükçıngı, A. (2014). Fen bilgisi öğretmen adaylarının fen öğretimine yönelik zihinsel modelleri, öz yeterlik inançları ve öğrenme yaklaşımları. *Ondokuz Mayıs Üniversitesi Eğitim Fakültesi Dergisi*, *33*(2), 404-423.

Finson, K., & Pederson, J. (2011). What are visual data and what utility do they have in science education?. *Journal of Visual Literacy*, *30*(1), 66-85.

Finson, K. D., Beaver, J. B., & Cramond, B. L. (1995). Development and field test of a checklist for the Draw-A-Scientist Test. *School science and mathematics*, *95*(4), 195-205.

Finson, K. D., Pedersen, J., & Thomas, J. (2006). Comparing science teaching styles to students' perceptions of scientists. *School Science and Mathematics*, *106*(1), 8-15.

Finson, K., Riggs, I. M., & Jesunathadas, J. (2000). The Relationship of Science Teaching Self Efficacy and Outcome Expectancy to the Draw-a-Science-Teacher-Teaching Checklist.

Fives, H., Hamman, D., & Olivarez, A. (2007). Does burnout begin with student-teaching? Analyzing efficacy, burnout, and support during the student-teaching semester. *Teaching and teacher education*, *23*(6), 916-934.

Fuller, F. F. (1969). Concerns of teachers: A developmental conceptualization. *American educational research journal*, *6*(2), 207-226.

Gibson, S., & Dembo, M. H. (1984). Teacher efficacy: A construct validation. *Journal of educational psychology*, *76*(4), 569.

Glynn, S. M., Taasoobshirazi, G., & Brickman, P. (2009). Science motivation questionnaire: Construct validation with nonscience majors. *Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching*, *46*(2), 127-146.

Goddard, R. D., Hoy, W. K., & Hoy, A. W. (2000). Collective teacher efficacy: Its meaning, measure, and impact on student achievement. *American educational research journal*, *37*(2), 479-507.

Görecek Baybars, M. (2017). What Kind Of" Teacher" Do I Want To Be? Part-I. *Journal of Kirsehir Education Faculty*, *18*(2).

Greenglass, E. R., & Burke, R. J. (2003). Teacher stress. In *Occupational stress in the service professions* (pp. 227-250). CRC Press.

Gu, Q. & Day, C., (2007). Variations in the conditions for teachers' professional learning and development: Sustaining commitment and effectiveness over a career. *Oxford review of education*, *33*(4), 423-443.

Guo, Y., Connor, C. M., Yang, Y., Roehrig, A. D., & Morrison, F. J. (2012). The effects of teacher qualification, teacher self-efficacy, and classroom practices on fifth graders' literacy outcomes. *The Elementary School Journal*, *113*(1), 3-24.

Guskey, T. R., Passaro, P. D., & Wheeler, W. (1995). Mastery learning in the regular classroom: Help for at-risk students with learning disabilities. *Teaching exceptional children*, *27*(2), 15-18.

Hong, Y. Y., Chiu, C. Y., Dweck, C. S., Lin, D. M. S., & Wan, W. (1999). Implicit theories, attributions, and coping: a meaning system approach. *Journal of Personality and Social psychology*, *77*(3), 588.

Hoy, A. W., Hoy, W. K., & Davis, H. A. (2009). Teachers' self-efficacy beliefs.

Hoy, A. W., & Spero, R. B. (2005). Changes in teacher efficacy during the early years of teaching: A comparison of four measures. *Teaching and teacher education*, *21*(4), 343-356.

Hoy, W. K., & Tarter, C. J. (2004). Organizational justice in schools: No justice without trust. *International Journal of Educational Management*.

Hoy, W. K., & Woolfolk, A. E. (1993). Teachers' sense of efficacy and the organizational health of schools. *The elementary school journal*, *93*(4), 355-372.

Ignat, A. A., & Clipa, O. (2010). The Impact of Self-Efficacy and Locus of Control on the Professional Development of the Teachers. *Petroleum-Gas University of Ploiesti Bulletin, Educational Sciences Series*, *62*.

Imants, J. G., & De Brabander, C. J. (1996). Teachers' and principals' sense of efficacy in elementary schools. *Teaching and Teacher Education*, *12*(2), 179-195.

Ingersoll, R. M. (2001). Teacher turnover and teacher shortages: An organizational analysis. *American educational research journal*, *38*(3), 499-534.

Kaçar, T., & Beycioğlu, K. (2017). İlköğretim öğretmenlerinin öz yeterlik inançları. *Elementary Education Online*, *16*(4).

Kalkan, F. (2020). The relationship between teachers' self-efficacy beliefs and job satisfaction levels: A meta-analysis study. *Egitim ve Bilim*, *45*(204).

Kieffer, K. M., & Henson, R. K. (2000). Development and Validation of the Sources of Self-Efficacy Inventory (SOSI): Exploring a New Measure of Teacher Efficacy.

Kinskey, M. (2018). Using action research to improve science teaching self-efficacy. *International Journal of Science Education*, *40*(15), 1795-1811.

Kiran, D., & Sungur, S. (2018). Science Teachers' Motivation and Job Satisfaction in Relation to Perceived School Context.

Kıran, D. (2021). A Quantitative Investigation of Final Year Preservice Science Teachers' Sources of Self-Efficacy Beliefs. *International Journal of Contemporary Educational Research*, *8*(4), 47-58.

Klassen, R. M., & Usher, E. L. (2010). Self-efficacy in educational settings: Recent research and emerging directions. *The decade ahead: Theoretical perspectives on motivation and achievement*.

Klassen, R. M., Tze, V. M., Betts, S. M., & Gordon, K. A. (2011). Teacher efficacy research 1998–2009: Signs of progress or unfulfilled promise?. *Educational psychology review*, *23*(1), 21-43.

Klassen, R. M., & Chiu, M. M. (2010). Effects on teachers' self-efficacy and job satisfaction: Teacher gender, years of experience, and job stress. *Journal of educational Psychology*, *102*(3), 741.

Klusmann, U., Kunter, M., Trautwein, U., Lüdtke, O., & Baumert, J. (2008). Teachers' occupational well-being and quality of instruction: The important role of self-regulatory patterns. *Journal of educational psychology*, *100*(3), 702

Lee, K. (1996). A study of teacher responses based on their conceptions of intelligence. *The Journal of Classroom Interaction*, 1-12.

Leroy, N., Bressoux, P., Sarrazin, P., & Trouilloud, D. (2007). Impact of teachers' implicit theories and perceived pressures on the establishment of an autonomy supportive climate. *European journal of psychology of education*, *22*(4), 529-545.

Locke, E. A. (1969). What is job satisfaction?. *Organizational behavior and human performance*, *4*(4), 309-336.

Looney, L. (2003). Understanding teachers' efficacy beliefs: The role of professional community. Dissertation Abstracts International Section A: Humanities and Social Sciences, 64(12-A), 4357.

Lunenburg, F. (2011). Self-efficacy in the workplace: implications for motivation and performance. International Journal of Management, Business, And Administration, 14(1)

Lynott, D. J., & Woolfolk, A. E. (1994). Teachers' implicit theories of intelligence and their educational goals. *Journal of Research & Development in Education*.

Menon, D. (2020). Influence of the sources of science teaching self-efficacy in preservice elementary teachers' identity development. *Journal of Science Teacher Education*, *31*(4), 460-481.

Michaelowa, K., & Wittmann, E. (2007). The cost, satisfaction, and achievement of primary education-Evidence from Francophone Sub-Saharan Africa. *The Journal of Developing Areas*, 51-78.

Midgley, C., Feldlaufer, H., & Eccles, J. S. (1989). Change in teacher efficacy and student self-and task-related beliefs in mathematics during the transition to junior high school. *Journal of educational Psychology*, *81*(2), 247.

Ministry of National Education of Turkey [MONE]. (2020). TIMMS national report. Retrieved on February 16, 2021 from http://timss.meb.gov.tr/www/timss-2019-sonuclari-aciklandi/icerik/8

Minogue, J. (2010). What is the teacher doing? What are the students doing? An application of the draw-a-science-teacher-test. *Journal of Science Teacher Education*, *21*(7), 767-781.

Miskel, C., McDonald, D., & Bloom, S. (1983). Structural and expectancy linkages within schools and organizational effectiveness. *Educational Administration Quarterly*, *19*(1), 49-82.

Mohamadi, F. S., Asadzadeh, H., Ahadi, H., & Jomehri, F. (2011). Testing Bandura's Theory in school. *Procedia-Social and Behavioral Sciences*, *12*, 426-435.

Moore, W., & Esselman, M. (1992, April). Teacher efficacy, power, school climate and achievement: A desegregating district's experience. In *annual meeting of the American Educational Research Association, San Francisco*.

O'Neill, S., & Stephenson, J. (2012). Exploring Australian pre-service teachers sense of efficacy, its sources, and some possible influences. *Teaching and Teacher Education*, *28*(4), 535–545. https://doi.org/10.1016/j.tate.2012.01.008

Ololube, N. P. (2006). Teachers job satisfaction and motivation for school effectiveness: An assessment. *Essays in Education*, *18*(1), 9.

Oppermann, E., Brunner, M., & Anders, Y. (2019). The interplay between preschool teachers' science self-efficacy beliefs, their teaching practices, and girls' and boys' early science motivation. *Learning and Individual Differences*, *70*, 86-99.

Pajares, F. (1996). Self-efficacy beliefs and mathematical problem-solving of gifted students. *Contemporary educational psychology*, *21*(4), 325-344.

Pajares, F., & Schunk, D. (2001). The development of academic self-efficacy. *Development of achievement motivation. United States*, *7*, 1-27.

Palazzolo, S. (2016). *The relationship between mindset and self-efficacy in pre-service elementary teacher candidates teaching science, and its implications on science teaching* (Doctoral dissertation, University of Windsor (Canada).

Palmer, D. H. (2006). Sources of self-efficacy in a science methods course for primary teacher education students. *Research in science education*, *36*(4), 337-353.

Pamuk, S., Sungur, S., & Oztekin, C. (2017). A multilevel analysis of students' science achievements in relation to their self-regulation, epistemological beliefs, learning environment perceptions, and teachers' personal characteristics. *International Journal of Science and Mathematics Education*, *15*(8), 1423-1440.

Pintrich, P. R., & De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of educational psychology*, *82*(1), 33.

Plaks, J. E., Grant, H., & Dweck, C. S. (2005). Violations of implicit theories and the sense of prediction and control: Implications for motivated person perception. *Journal of personality and social psychology*, *88*(2), 245.

Poulou, M. S., Reddy, L. A., & Dudek, C. M. (2019). Relation of teacher self-efficacy and classroom practices: A preliminary investigation. *School Psychology International*, *40*(1), 25-48.

Riggs,I.M. & Enochs,L.G. (1990). Toward the development of an elementary teachers' science teaching eficacy belief instrument. ScienceEducation,74,625-637.

Rosenholtz, S. J. (1989). Workplace conditions that affect teacher quality and commitment: Implications for teacher induction programs. *The Elementary School Journal*, *89*(4), 421-439.

Ross, J. A., Hogaboam-Gray, A., & Hannay, L. (2001). Effects of teacher efficacy on computer skills and computer cognitions of Canadian students in grades K-3. *The Elementary School Journal*, *102*(2), 141-156.

Rubeck, M., & Enochs, L. (1991, April). A path analytic model of variables that influence science and chemistry teaching self-efficacy and outcome expectancy in middle school science teachers. In *annual meeting of the National Association for Research in Science Teaching, Lake Geneva, WI*.

Sahranç, Ü. (2007). Stres kontrolü, genel öz-yeterlik, durumluk kaygı ve yaşam doyumuyla ilişkili bir akış modeli. *Yayımlanmamış Doktora Tezi, Gazi Üniversitesi, Ankara*.

Schaffer, E., Stringfield, S., & Wolfe, D. (1992). An innovative beginning teacher induction program: A two-year analysis of classroom interactions. *Journal of Teacher Education*, *43*(3), 181-192.

Schunk, D. H. (2003). Self-efficacy for reading and writing: Influence of modeling, goal setting, and self-evaluation. *Reading &Writing Quarterly*, *19*(2), 159-172.

Schwarzer, R., & Hallum, S. (2008). Perceived teacher self-efficacy as a predictor of job stress and burnout: Mediation analyses. *Applied psychology*, *57*, 152-171.

Sezgintürk, M., & Sungur, S. (2020). A multidimensional investigation of students' science self-efficacy: The role of gender. *İlkogretim Online-Elementary Education Online*, *19*(1), 208-218.

Simmons, Emory, Carter, Coker, Finnegan, Crockett, Richardson, Yager, Craven, Tillotson, Brunkhorst, Twiest, Hossain, Gallagher, Duggan-Haas, Parker, Cajas, Alshannag, Mc- Glamery, Krockover, Adams, Spector, LaPorta, James, Rearden, & Lubuda. (1999). Be- ginning teachers: beliefs and classroom actions. *Journal of Research in Science Teaching, 36* (8), 930-954.

Skaalvik, E. M., & Skaalvik, S. (2007). Dimensions of teacher self-efficacy and relations with strain factors, perceived collective teacher efficacy, and teacher burnout. *Journal of educational psychology*, *99*(3), 611.

Skaalvik, E. M., & Skaalvik, S. (2010). Teacher self-efficacy and teacher burnout: A study of relations. *Teaching and teacher education*, *26*(4), 1059-1069.

Strosher, H. L. W. (2003). Prospective and practicing teachers' beliefs: a study of implicit theories of intelligence and teacher efficacy.

Stipek, D. (2002). Good instruction is motivating. In *Development of achievement motivation* (pp. 309-332). Academic Press.

Tabachnick, B. G., Fidell, L. S., & Ullman, J. B. (2007). *Using multivariate statistics* (Vol. 5, pp. 481-498). Boston, MA: pearson.

Tamir, M., John, O. P., Srivastava, S., & Gross, J. J. (2007). Implicit theories of emotion: affective and social outcomes across a major life transition. *Journal of personality and social psychology*, *92*(4), 731.

Tatar, N., Yildiz Feyzioglu, E., Buldur, S., & Akpinar, E. (2012). Pre-Service Science Teachers' Mental Models about Science Teaching. *Educational Sciences: Theory and Practice*, *12*(4), 2934-2940.

Thomas, J. A., & Pedersen, J. E. (2003). Reforming elementary science teacher preparation: What about extant teaching beliefs?. *School Science and Mathematics*, *103*(7), 319-330.

Thomas, J. A., Pedersen, J. E., & Finson, K. (2001). Validating the Draw-A-Science-Teacher-Test- Checklist (DASTT-C): Exploring mental models and teacher beliefs. Journal of Science Teacher Education, 12 (4), 295- 310.

Toland, M. D., & Usher, E. L. (2016). Assessing mathematics self-efficacy: How many categories do we really need?. *The Journal of Early Adolescence*, *36*(7), 932-960.

Tschannen-Moran, M., Hoy, A. W., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of educational research*, *68*(2), 202-248.

Tschannen-Moran, M., & Hoy, A. W. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and teacher education*, *17*(7), 783-805.

Tschannen-Moran, M., & Hoy, A. W. (2007). The differential antecedents of self-efficacy beliefs of novice and experienced teachers. *Teaching and teacher Education*, *23*(6), 944-956.

Tuan*, H. L., Chin, C. C., & Shieh, S. H. (2005). The development of a questionnaire to measure students' motivation towards science learning. *International journal of science education*, *27*(6), 639-654.

Türkoglu, M. E., Cansoy, R., & Parlar, H. (2017). Examining Relationship between Teachers' Self-Efficacy and Job Satisfaction. *Universal Journal of Educational Research*, *5*(5), 765-772.

Usher, E. L., & Pajares, F. (2008). Sources of self-efficacy in school: Critical review of the literature and future directions. *Review of educational research*, *78*(4), 751-796.

Uzuntiryaki, E. (2008). Exploring the sources of Turkish pre-service chemistry teachers' chemistry self-efficacy beliefs. *Australian Journal of Teacher Education (Online)*, *33*(6), 12-28.

Uzuntiryaki, E., & Aydın, Y. Ç. (2009). Development and validation of chemistry self-efficacy scale for college students. *Research in Science Education*, *39*(4), 539-551.

Van Uden, J. M., Ritzen, H., & Pieters, J. M. (2014). Engaging students: The role of teacher beliefs and interpersonal teacher behavior in fostering student

engagement in vocational education. *Teaching and Teacher Education*, *37*, 21-32.

Velthuis, C., Fisser, P., & Pieters, J. (2014). Teacher training and pre-service primary teachers' self-efficacy for science teaching. *Journal of science teacher education*, *25*(4), 445-464.

Yerdelen, S. (2013). Multilevel investigations of students' cognitive and affective learning outcomes and their relationships with perceived classroom learning environment and teacher effectiveness

Yerdelen, S., Sungur, S., & Klassen, R. (2016). Relationship between Turkish elementary science teachers occupational well being and some contextual and demographic characteristics A multivariate analysis.

Yerdelen, S., & Sungur, S. (2019). Multilevel investigation of students' self-regulation processes in learning science: Classroom learning environment and teacher effectiveness. *International Journal of Science and Mathematics Education*, *17*(1), 89-110.

Zundans-Fraser, L., & Lancaster, J. (2012). Enhancing the inclusive self-efficacy of preservice teachers through embedded course design. *Education Research International*, *2012*.

Wang, Y. L., & Tsai, C. C. (2019). Exploring the structure of science learning self-efficacy: The role of science learning hardiness and perceived responses to capitalization attempts among Taiwanese junior high school students. *Research in Science & Technological Education*, *37*(1), 54-70.

Williams, A. Y. (2012). *Applications of Dweck's model of implicit theories to teachers' self-efficacy and emotional experiences*. University of Maryland, College Park.

Whyte, A., & Ellis, N. (2003). Graphic representation as a bridge to understanding conceptual teaching. *Arts and Learning Research Journal*, *19*(1), 167-194.

Wolters, C. A., & Daugherty, S. G. (2007). Goal structures and teachers' sense of efficacy: Their relation and association to teaching experience and academic level. *Journal of educational psychology*, *99*(1), 181.

Woolfolk, A. E., & Hoy, W. K. (1990). Prospective teachers' sense of efficacy and beliefs about control. *Journal of educational Psychology*, *82*(1), 81.

Woolfolk, A. E., Rosoff, B., & Hoy, W. K. (1990). Teachers' sense of efficacy and their beliefs about managing students. *Teaching and teacher Education*, *6*(2), 137-148.

APPENDICES

A. DEMOGRAPHIC INFORMATION QUESTIONNAIRE

ÖĞRETMEN ANKETİ
Sayın Fen Bilimleri Öğretmeni, Bu çalışmada size öğretmenlik mesleğine karşı algılarınıza yönelik çeşitli sorular sorulmaktadır. Lütfen her cümleyi okuduktan sonra, size en uygun gelen seçeneği mutlaka işaretleyiniz. 'Doğru' ya da 'Yanlış' cevap yoktur. Sizden hiçbir şekilde kimlik bilgilerinizi belirten bir bilgi istenmemektedir. Ayrıca anketlere verdiğiniz cevaplar araştırmacılar tarafından gizli tutulacaktır. Bu nedenle sorulara içtenlikle cevap vermenizi rica ederiz. Merve PEHLİVAN (ODTÜ) Prof. Dr. Semra SUNGUR (ODTÜ)
BÖLÜM A.

1.	Cinsiyetiniz:	
2.	Yaşınız:	
3.	Çalıştığınız şehir:	
4.	Üniversitede eğitim gördüğünüz fakültenin adı:	
5.	Üniversitede eğitim gördüğünüz bölümün adı:	
6.	Şu anki eğitim durumunuz nedir?	
7.	Kaç yıldır öğretmenlik yapıyorsunuz?	
8.	Girdiğiniz sınıflardaki ortalama öğrenci sayısı:	
9.	Haftalık ortalama ders saatiniz:	

B. TEACHERS' SENSE OF SELF-EFFICACY SCALE

B3. Aşağıda belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.										
		Yetersiz		Çok az yeterli		Biraz Yeterli		Oldukça yeterli		Çok Yeterli
1	Sınıfta fen bilimleri dersini olumsuz yönde etkileyen davranışları kontrol etmeyi ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
2	Fen bilimleri dersine az ilgi gösteren öğrencileri motive etmeyi ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
3	Öğrencileri fen bilimleri dersinde başarılı olabileceklerine inandırmayı ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
4	Öğrencilerin fen bilimleri dersini öğrenmeye değer vermelerini ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
5	Fen bilimleri dersinde öğrencilerinizin iyi bir şekilde değerlendirilmesine olanak sağlayacak soruları ne ölçüde hazırlayabilirsiniz?	1	2	3	4	5	6	7	8	9
6	Fen bilimleri derslerinde öğrencilerin sınıf kurallarına uymalarını ne kadar sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
7	Fen bilimleri dersini olumsuz yönde etkileyen ya da derste gürültü yapan öğrencileri ne kadar yatıştırabilirsiniz?	1	2	3	4	5	6	7	8	9
8	Fen bilimleri derslerinde farklı öğrenci gruplarına uygun sınıf yönetim sistemini ne kadar iyi oluşturabilirsiniz?	1	2	3	4	5	6	7	8	9
9	Fen bilimleri derslerinde farklı değerlendirme yöntemlerini ne kadar kullanabilirsiniz?	1	2	3	4	5	6	7	8	9
10	Fen bilimleri derslerinde öğrencilerin kafası karıştığında ne kadar alternatif açıklama ya da örnek sağlayabilirsiniz?	1	2	3	4	5	6	7	8	9
11	Çocukların fen bilimleri dersinde başarılı olmalarına yardımcı olmaları için ailelerine ne kadar destek olabilirsiniz?	1	2	3	4	5	6	7	8	9
12	Fen bilimleri derslerinde farklı öğretim yöntemlerini ne kadar iyi uygulayabilirsiniz?	1	2	3	4	5	6	7	8	9

C. SOURCES OF SELF-EFFICACY INVENTORY

B4. Aşağıda belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.								
		Kesinlikle doğru değil	Genellikle doğru değil	Bazen doğru	Ara sıra doğru	Çoğunlukla doğru	Genellikle Doğru	Her zaman doğru
1	Öğretme konusunda birçok olumlu fırsatım oldu.	1	2	3	4	5	6	7
2	Diğer öğretmenlerin, öğretmenlik üzerine. konuşmalarını dinlemek, bana öğretmenlik hakkında yararlı bilgiler sağlar.	1	2	3	4	5	6	7
3	Diğer öğretmenlerden aldığım övgüler daha iyi hissetmemi sağlar.	1	2	3	4	5	6	7
4	Öğrencilere yanlış bilgiler aktardığımda kaygılanırım.	1	2	3	4	5	6	7
5	Diğer öğretmenlerin hatalarını gözlemlemek bana nasıl daha etkili bir öğretmen olunabileceğini öğretti.	1	2	3	4	5	6	7
6	Öğrencilere iyi öğrettiğim zamanları net olarak hatırlarım.	1	2	3	4	5	6	7
7	Sınıfta öğretmen olarak bulunma düşüncesi beni endişelendiriyor.	1	2	3	4	5	6	7
8	Öğretmenleri sınıf ortamında gözlemlemek için önemli fırsatlarım oldu.	1	2	3	4	5	6	7
9	Sınıf içindeki öğretme deneyimlerimden çok şey öğrendim.	1	2	3	4	5	6	7
10	Saygı duyduğum insanlar, iyi bir öğretmen olduğumu söylediğinde onlara inanırım.	1	2	3	4	5	6	7
11	Öğrencilere bir şeyler öğretmeye çalışırken başarılı oldum.	1	2	3	4	5	6	7
12	Yetenekli öğretmenleri gözlemleyerek nasıl öğretmen olunacağını öğrendim.	1	2	3	4	5	6	7
13	Hata yapma korkum öğretme yeteneğimi etkiler.	1	2	3	4	5	6	7
14	Öğretmenliğe yönelik yeteneğim olduğunu duymak beni daha iyi öğretmeye teşvik eder.	1	2	3	4	5	6	7
15	Öğretimle ilgili hatalarımdan ders çıkarabilirim.	1	2	3	4	5	6	7
16	Öğrencilerle iletişim kuramamak beni korkutur.	1	2	3	4	5	6	7
17	Verdiğim dersler daha etkili öğretme stratejileri ve becerileri geliştirmemi sağladı.	1	2	3	4	5	6	7
18	Diğer öğretmenlerin yaptığı hataları gözlemleyerek kendi öğretmenliğim hakkında güven kazandım.	1	2	3	4	5	6	7
19	Diğer öğretmenlerin, iyi öğretmen olduğumu söylemeleri beni daha iyi öğretmeye motive eder.	1	2	3	4	5	6	7
20	İyi öğretebilmeyi kişisel başarı olarak değerlendiririm.	1	2	3	4	5	6	7
21	Diğer öğretmenlerin eksiklerini gördükçe nasıl daha etkili öğretebileceğimi öğrenebilirim.	1	2	3	4	5	6	7
22	Öğretirken hata yaptığım zamanlarda kalp atışlarımın hızlandığını hissederim.	1	2	3	4	5	6	7
23	Öğretmenlik becerilerim hakkında sık sık deneyimli insanlardan önemli geri bildirimler alırım.	1	2	3	4	5	6	7
24	Etkili bir öğretim ortamı sağlayamama düşüncesi beni endişelendirir.	1	2	3	4	5	6	7
25	Öğretmenlik becerilerimin çoğunu gerçek ortamda öğretmenlik yaparak geliştirdim.	1	2	3	4	5	6	7
26	Etkili öğretme konusunda diğerlerinin önerilerinden çok şey öğrenirim.	1	2	3	4	5	6	7
27	Öğrencilerin derse katılımını sağlayamadığımda kaygılanırım.	1	2	3	4	5	6	7

D. TEACHER JOB SATISFACTION SCALE

BÖLÜM B.

B1. Aşağıda belirtilen ifadelerde sizi en iyi yansıtan seçeneği işaretleyiniz.

		Hiç					Çok Fazla
1	Mesleğinizi tüm yönleriyle ele aldığınızda, öğretmen olarak çalışmaktan ne kadar zevk alıyorsunuz?	1	2	3	4	5	6
		Kesinlikle Hayır					Hiç Düşünmeden Evet
2	Eğer bugün mesleğinizi seçme şansınız olsaydı, öğretmen olmayı seçer miydiniz?	1	2	3	4	5	6
		Hiçbir Zaman					Her Zaman
3	Öğretmenlik mesleğini bırakmayı hiç düşündünüz mü?	1	2	3	4	5	6

E. IMPLICIT THEORY OF SCIENCE ABILITY SCALE

B2. Aşağıda belirtilen ifadelere ne derecede katıldığınızı ya da katılmadığınızı gösteren seçeneği işaretleyiniz.

		Kesinlikle Katılıyorum	Katılıyorum	Biraz Katılıyorum	Biraz Katılmıyorum	Katılmıyorum	Kesinlikle Katılmıyorum
1	Kişiler fen bilimlerine yönelik belirli bir yeteneğe sahiptir ve bunu değiştirmek için pek bir şey yapamazlar.	1	2	3	4	5	6
2	Kişilerin fen bilimlerine yönelik yetenekleri tamamen kendileriyle ilgili bir şeydir ve onu çok fazla değiştiremezler.	1	2	3	4	5	6
3	Dürüst olmak gerekirse, insanlar fen bilimleri alanında ne kadar yetenekli olduklarını değiştiremezler.	1	2	3	4	5	6
4	Kişiler fen bilimleri konularında yeni bir şeyler öğrenebilir fakat, fen bilimlerine yönelik temel yeteneklerini değiştiremezler.	1	2	3	4	5	6

F. DRAW A SCIENCE TEACHER TEST-CHECKLIST

Bölüm C. FEN ÖĞRETMENİ ÇİZİM TESTİ

C.1. Kendinizi ders ortamında fen bilimleri öğretmeni olarak çiziniz.

C2. Öğretmen ne yapıyor? Öğrenciler ne yapıyor?

G. PERMISSION FROM METU HUMAN RESEARCH ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY
T: +90 312 210 22 91
F: +90 312 210 79 59
ueam@metu.edu.tr
www.ueam.metu.edu.tr

Sayı: 28620816 /

09 ARALIK 2021

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Semra SUNGUR

Danışmanlığını yürüttüğünüz Merve PEHLİVAN'ın "Fen Bilimleri Öğretmenlerinin Öz-Yeterliklik Algılarının Kaynakları ve Sonucuna İlişkin Bir Çalışma" başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **499-ODTU-2021** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

Prof.Dr. Mine MISIRLISOY
İAEK Başkan

H. PERMISSION FROM THE MINISTRY OF EDUCATION OF TURKEY

T.C.
ANKARA VALİLİĞİ
Milli Eğitim Müdürlüğü

Sayı : E-14588481-605.99-40009046 28.12.2021
Konu : Araştırma İzni

ORTA DOĞU TEKNİK ÜNİVERSİTESİ REKTÖRLÜĞÜNE
(Öğrenci İşleri Daire Başkanlığı)

İlgi : a)MEB Yenilik ve Eğitim Teknolojileri Genel Müdürlüğünün 2020/2 nolu Genelgesi.
b)06.12.2021 tarihli ve 259 sayılı yazınız.

Üniversiteniz Matematik ve Fen Bilimleri Eğitimi Ana Bilim Dalı Yüksek Lisans öğrencisi Merve PEHLİVAN'ın **"Fen Bilimleri Öğretmenlerinin Öz-Yeterlilik Algılarının Kaynakları ve Sonucuna İlişkin Bir Çalışma"** konulu çalışması kapsamında İlimiz 9 merkez ilçesindeki Okul ve Kurumlarda, uygulama talebi ilgi (a) Genelge çerçevesinde incelenmiştir.

Yapılan inceleme sonucunda, söz konusu araştırmanın Müdürlüğümüzde muhafaza edilen ölçme araçlarının; Türkiye Cumhuriyeti Anayasası, Milli Eğitim Temel Kanunu ile Türk Milli Eğitiminin genel amaçlarına uygun olarak; ilgili yasal düzenlemelerde belirtilen ilke, esas ve amaçlara aykırılık teşkil etmeyecek, eğitim-öğretim faaliyetlerini aksatmayacak şekilde okul ve kurum yöneticilerinin sorumluluğunda gönüllülük esasına göre uygulanması Müdürlüğümüzce uygun görülmüştür.

Bilgilerinizi ve gereğini rica ederim.

Harun FATSA
Vali a.
Milli Eğitim Müdürü

Dağıtım:
Gereği:
Orta Doğu Teknik Üniversitesi

Bilgi:
9 İlçe MEM

Bu belge güvenli elektronik imza ile imzalanmıştır.
Adres :
Belge Doğrulama Adresi : https://www.turkiye.gov.tr/meb-ebys
Bilgi için:
Telefon No : 0 (312) 306 89 06
Unvan : Veri Hazırlama ve Kontrol İşletmeni
E-Posta: istatistik06@meb.gov.tr
İnternet Adresi: Faks:
Kep Adresi : meb@hs01.kep.tr
Bu evrak güvenli elektronik imza ile imzalanmıştır. https://evraksorgu.meb.gov.tr adresinden b191-efff-3706-ab39-33e5 kodu ile teyit edilebilir.

İ. TURKISH SUMMARY

FEN BİLİMLERİ ÖĞRETMENLERİNİN ÖZ-YETERLİK ALGILARININ KAYNAKLARI VE SONUCUNA İLİŞKİN BİR ÇALIŞMA

GİRİŞ

Bandura'nın Sosyal Bilişsel Teorisine (1977) göre, öğretim öz-yeterliği "öğretmenin belirli durumlarda belirli öğretim görevlerini başarılı bir şekilde tamamlamak için gerekli olan eylemleri organize etme ve yürütme yeteneğine olan inancı" olarak tanımlanır (Tschannen-Moran, Hoy & Hoy, 1998, s.207). Tschannen-Moran et al. (1998), öğretmenlerin öğretim öz-yeterliğini öğretim stratejileri için öz-yeterlik, sınıf yönetimi için öz-yeterlik, ve öğrenci katılımı için öz yeterlik olarak üç boyuta ayırmıştır. Öğretme öz-yeterliği, öğretirken fikir ve eylemleri oluşturabilen ve yönlendirebilen güçlü bir inanç olarak düşünülebilir (Pamuk, Sungur ve Öztekin, 2017). Buna göre, öğretmenlerin öğretme öz-yeterliği, arzu edilen birçok öğretmen çıktısı ve öğrenci çıktısı ile ilişkilidir. Çok sayıda araştırma, öğretme öz yeterliğinin öğrenci başarısı (Caprara, Barbaranelli, Steca & Malone, 2006; Guo, Connor, Yang, Roehrig & Morrison, 2012; Woolfolk-Hoy & Davis, 2009), öğrenci motivasyonu (Ashton & Webb, 1986) ve öğrenci öz yeterliliği (Ross, Hogaboam-Gray & Hannay, 2001) gibi çeşitli öğrenci sonuçlarını etkilediğini ortaya koymuştur. Ayrıca, öğretme öz yeterliliğinin öğrencilerin davranışsal, bilişsel ve duygusal katılımıyla olumlu bir şekilde bağlantılı olduğu bildirilmektedir (van Uden, Ritzen & Pieters, 2014).

Ayrıca, öğretmenlerin öğretim öz-yeterliği, öğrenci merkezli veya öğretmen merkezli uygulamalara ilişkin öğretim inançlarını ve açık, kavramsal veya keşfedici öğretim tarzlarını etkileyebilir (Finson, Pedersen & Thomas 2006; Thomas, Pedersen & Finson, 2001). Thomas ve arkadaşlarını (2001) bu üç ana öğretim stili terimini dikkatli bir şekilde tanımlamıştır. Birincisi, ağırlıklı olarak öğretmen merkezli

öğretim yöntemlerinden oluşan açık öğretim stilidir. Bilginin içeriği esas olarak öğretmen tarafından öğrenciye iletilir. İkincisi, öğretmenin ders içeriğini doğrudan sağladığı ve öğrencilerin materyallerle etkileşime girdiği kavramsal öğretim stilidir. Üçüncü ise keşfedici öğretim stilidir ve çoğunlukla öğrenci merkezli öğretim yöntemlerinden oluşur ve sorgulamaya dayalı öğretim yöntemlerini kullanır. Öğretmen derste rehber rolünü üstlenir ve öğrenciler aktif olarak katılım gösterirler. Thomas ve arkadaşları (2001) öğretmenlerin öğretme inançları ve öğretme stilleri hakkındaki zihinsel modellerini incelemek için "Fen Öğretmeni Çizim Testi-Kontrol Listesi" (DASTT-C) ölçme aracını geliştirmiştir. Bu araç sayesinde öğretmenler, öğrencilerin ve öğretmenlerin ne yaptığını göz önünde bulundurarak sınıf ortamlarını çizerler. Ölçeğin bir parçası olan kontrol listesine göre, araştırmacılar çizimleri derecelendirir ve ardından öğretmenlerin öğretim inançlarına ve stillerine karar verirler. Ölçekten alınan yüksek puanlar, daha çok öğretmen merkezli inancı göstermektedir. Literatürde fen bilimleri öğretmenlerinin öz-yeterlik inançları ile DASTT-C aracını kullanarak öğretim stilleri arasındaki ilişkiyi araştıran birçok araştırma bulunmaktadır (Finson, Riggs & Jesunathadas, 2000; Feyzioğlu, Feyzioğlu & Küçükçıngı, 2014; Rubeck & Enochs, 1990; Finson vd., 2006; Sibel, 2017). Mevcut araştırmalar incelendiğinde, öz-yeterliği yüksek olan öğretmenlerin keşfedici öğretim stilini kullanarak öğrenci merkezli öğretim inançlarını uygulamaya daha istekli oldukları, öz-yeterliği düşük olan öğretmenlerin ise öğretmen merkezli uygulamalara daha yatkın oldukları ortak ve önemli bir sonuçtur (Finson vd., 2000; Finson vd., 2006; Rubeck & Enochs, 1990; Sibel, 2017). Bu çalışmada fen bilimleri öğretmenlerinin öğretim öz-yeterliklerinin bir sonucu olarak öğretim inançları incelenecektir. Ayrıca öğretmenlerin öğretim stillerine ilişkin öz-yeterlikleri araştırılacaktır. Bu amaçla, DASTT-C ölçme aracı kullanılarak hizmet içi fen bilgisi öğretmenlerinin sınıf ortamlarına ilişkin çizimleri analiz edilecektir.

Bu çalışmada, öğretmen öz yeterliğinin sonucunun yanı sıra, öğretmenlerin öğretme öz yeterliklerinin kaynaklarını açıklayacaktır. Bandura'ya (1997) göre, öz-yeterlik

inançları, farklı kaynakları seçmeyi ve tartmayı içeren bilişsel sürecin bir sonucu olarak geliştirilir. Literatür taramasına dayalı olarak, öğretim öz-yeterlik kaynakları, Bandura'nın varsaydığı dört kaynak, iş tatmini, öğretmenlik deneyimi yılları ve öğretmenlerin örtük fen yeteneği teorisi açısından araştırılabilir (Bandura, 1997; Hoy, 2004; Kıran, 2021; Kalkan, 2020; Kiran & Sungur, 2018; Klassen & Chiu, 2010; Yerdelen & Sungur, 2019; Wolters & Dougherty, 2017). Dolayısıyla bu çalışmada bu kaynaklar fen bilgisi öğretmenlerinin öğretim öz-yeterliklerinin potansiyel kaynakları olarak değerlendirilecektir.

Bandura'ya (1997) göre öz-yeterliliğin dört temel kaynağı vardır; doğrudan yaşantılar, dolaylı yaşantılar, sözel ikna, ve psikolojik durum. Öğretmenlerin fen öğretimine yönelik öz-yeterliliği, Bandura'nın özyeterlik kaynakları olarak öne sürdüğü dört etken kullanılarak açıklanabilir. Bu kaynaklardan en etkilisi doğrudan yaşantılar, yani bireylerin doğrudan kendi başarılı veya başarısız deneyimlerinden kazandığı bilgilerdir (Bandura, 1995; Britner & Pajares, 2006; Pajares, Johnson & Usher, 2007; Usher & Pajares, 2009). Öğretmenler, gerçekleştirdikleri öğretim sonunda performanslarını değerlendirerek, benzer performansları gerçekleştirme kapasiteleri konusunda bir yeterlik yargısı geliştirirler ve sonraki öğretimlerinde geliştirdikleri bu inançlara göre hareket ederler (Bandura, 1986). Öğretmenlerin başarılı deneyimleri özyeterlilik yargılarını artırırken, üst üste yaşadığı başarısızlıklar öz-yeterliliklerini düşürebilir. Bandura (1997), özyeterlik inancının zamanla oluştuğunu ve bir kez oluştuğu zaman da bu inançları değiştirmenin zor olduğunu belirtmektedir. Öğretmenler doğrudan edindikleri deneyimleri değerlendirmelerinin yanı sıra, diğer öğretmenlerin performanslarını gözlemleme sonucunda da (dolaylı yaşantılar) özyeterlik inancı geliştirirler. Fakat bu deneyimler, öz-yeterliliğin oluşmasında doğrudan elde edilen deneyimler kadar etkili değildir. Bandura'ya (1997) göre gözlenen model gözlemciye ne kadar çok benzerse, dolaylı yoldan edinilen bu deneyimlerin, bireyin öz-yeterliğine etkisi fazla olur. Öz-yeterliğin şekillenmesinde etkili olan bir diğer kaynak da sözel iknadır.

Öğretmenlerin özyeterlik inançları kendi profesyonel alanında görev yapan diğer kişilerin yorumlarından etkilenmektedir. Meslektaşların yanı sıra, ailenin sözel dönütleri de öğretmen öz-yeterliğini etkilemektedir ve dolayısıyla bu durum öğretmenin görevini gerçekleştirmedeki çabasını etkileyebilmektedir (Bandura, 1997). Geri bildirimde bulunan kişinin deneyimi, güvenilirliği ve inanılabilirliği iknaının gücünü belirler. Öz-yeterliği, olumsuz değerlendirmelerle düşürmek, olumlu yüreklendirmelerle artırmaktan daha kolaydır (Bandura, 1986). Son olarak, öğretmenlerin öğretimle ilgili yaşadıkları heyecan, gerginlik, korku gibi fizyolojik ve duygusal durumlar, bu uyarılmaların nasıl yorumladığına bağlı olarak, onların o konudaki kapasitelerine ilişkin yargılarının gelişimine katkıda bulunur. Olumlu duygular, öz-yeterliği güçlendirirken, olumsuz duygular zayıflatır.

Diğer araştırmacılar iş doyumunun öğretmenlerin sınıf yönetimi, öğretim stratejileri ve öğrenci katılımı konularında öğretim öz-yeterliklerini etkileyen diğer bir faktör olduğunu öne sürmüşlerdir (Buluç & Demir, 2015; Caprara, Barbaranelli, Steca & Malone, 2006; Kiran & Sungur, 2018; Klassen & Chiu, 2010; Skaalvik & Skaalvik, 2010). Öğretmen iş doyumu, "öğretmenlerin işlerine ve öğretim rollerine karşı duygusal tepkileri" olarak tanımlanmaktadır (Skaalvik & Skaalvik, 2017, s.154). Literatür taramasına göre öğretmen iş doyumu sınıftaki öğretmen performansını etkileyen önemli bir kaynaktır (Ollube, 2006). İşlerinden memnun olmayan öğretmenlerin mesleğe aidiyet duygusu düşüktür (Evans, 2001). İş doyumu duygusu yüksek öğretmenler ise problem çözmede, zamanı yönetmede, öğrencileri teşvik etmede ve sınıfta öğrenmeyi destekleyen ortam oluşturmada daha başarılıdır (Klussman vd., 2008; Demirtaş, 2010; Kiran ve Sungur, 2018).

Öğretmenlerin öğretmenlik deneyimi, sınıf yönetimi, öğretim stratejileri ve öğrenci katılımı için öğretim öz-yeterliliğini etkileyen alternatif bir faktördür (Campbell, 1996; Poulou, Reddy & Dudek, 2019; Wolters & Daugherty, 2017). Örneğin,

Wolters ve Daugherty (2017), daha fazla öğretmenlik deneyime sahip öğretmenlerin yeni öğretim yöntemlerini uygulamada ve müfredatı öğretmede daha etkili olduklarını belirtmişlerdir. Wolters ve Daugherty (2007) okul öncesi sınıftan yirminci sınıfa kadar öğretmenler üzerinde yaptıkları bir çalışmada öğretmenlik deneyimi ile öğretmen öz-yeterliği arasında pozitif bir ilişki olduğunu bildirmişlerdir. Bullock, Coplan ve Bosacki (2015) okul öncesi öğretmenleri üzerinde yaptıkları araştırmada, öğretmenlik deneyimi daha uzun olan öğretmenlerin sınıf yönetimine yönelik öğretmen öz-yeterliklerinin daha yüksek olduğunu belirtmişlerdir.

Ayrıca, ilgili literatüre göre öğretmenlerin örtük fen yeteneğine ilişkin örtük teorileri, öğretmen öz-yeterliklerinin bir başka potansiyel kaynağı olarak karşımıza çıkmaktadır. Öğretmenlerin fen yeteneğine ilişkin örtük teorileri, "fen bilimleri öğretmenlerinin, öğrencilerin fen alanındaki yeteneklerinin değişip değişmeyeceğine dair inançları" olarak tanımlanmaktadır (Yerdelen & Sungur, 2019, s.96). Öğretmenlerin örtük teorileri, fen yeteneği için artımsal veya varlık olabilir. Varlık teorisini benimseyen bazı öğretmenler, öğrencilerin fen becerilerinin sabit bir özellik olduğuna inanırlar ve öğrencilerin öğrenmeleri üzerinde hiçbir kontrolün olmadığını hissedebilirler (Dweck, 1996). Bu öğretmenlerin daha düşük öğretmen öz-yeterliklerine sahip olmaları beklenmektedir (Leroy, Bressoux, Sarrazin & Trouilloud, 2007). Bu öğretmenler başarısızlık konusunda endişelenirler, kolay görevleri seçme eğilimindedirler ve öğretim hedefleri öğrenci performansını artırmaktır (Dweck & Bempetchat, 1998; Klassen & Chiu, 2010; Tamir, John, Srivastava & Gross, 2007). Artımsal teorisini benimseyen öğretmenler ise, öğrencilerin fen yeteneklerinin şekillendirilebilir bir özellik olduğuna inanırlar ve bunu geliştirebileceklerini düşünebilirler (Dweck, 1996; Yerdelen & Sungur, 2019). Artımsal teoriye sahip öğretmenlerin öğretmen öz-yeterlikleri daha yüksektir (Leroy vd., 2007). Bu öğretmenler zorlu hedefler belirler, zorlu hedeflerde ısrarcıdır, yeni öğretim yöntemleri uygulama eğilimindedir ve öğretim hedefleri öğrencilerin

öğrenmesini artırmaktır (Dweck & Bempetchat, 1998; Klassen & Chiu, 2010; Tamir vd, 2007).

Fen eğitimi alanında birçok araştırmacı, çalışmalarında öğretim öz-yeterliliğinin alana özgü bir yapı olduğunu ileri sürmüşlerdir (Bandura, 1997; Çapa & Uzuntiryaki, 2009; Sezgintürk & Sungur, 2020; Tuan vd., 1997; Wang vd., 2018). Ancak, hizmet içi ortaokul öğretmenlerinin fen eğitiminde öğretim öz-yeterliklerini nasıl geliştirdikleri hakkında çok az şey bilinmektedir. Bu nedenle, bu çalışma fen bilgisi öğretmenlerinin potansiyel kaynaklarını ve sonuçlarını tek bir çalışmada inceleyerek öğretmenlerin fen öğretimine yönelik öz-yeterliliklerine odaklanmaktadır. Mevcut literatür benzer çalışmalar sunsa da, bu çalışma, tek regresyon modellerinde potansiyel öz-yeterlik kaynakları olarak ortaya çıkan değişkenleri bir araya getirmektedir. Bu nedenle, bu çalışma, diğer değişkenlerin varlığında her bir değişkenin katkısının incelenmesini sağlamaktadır. Buna göre, sonuçlar öğretmen eğitimi programları, fen alanındaki eğitimcileri ve araştırmacılar için daha doğru sonuçlar üretme potansiyeline sahiptir.

Bu çalışmada fen bilimleri öğretmenlerinin öğretim inançları ve öğretim stillerine ilişkin zihinsel modellerinin dikkate alınması çalışmanın başka bir önemini ortaya koymaktadır. DASTT-C ölçme aracı sayesinde, öğretmenlerin zihinsel modellerinin çizimleri yoluyla temel bilimin nasıl öğretileceğine ilişkin algıları, fikirleri, inançları ve kişisel teorileri hakkında daha derin açıklamalar oluşturmaya yardımcı olmuştur (Thomas, Pedersen ve Finson, 2001). Araç, farklı kültürlerde hem hizmet içi hem de öğretmen adayları için yaygın olarak kullanılmış ve ayrıca öz-yeterlik ve bilimin doğası gibi çeşitli bağlamlarla olan ilişkileri incelemek için kullanılmıştır (Ambusaidi & Balushi, 2011; Bilican, Ozdem-Yılmaz, & Oztekin, 2014; Buldur, 2017; Elmas, Demirdogen, & Geban, 2011; Finson, Pederson, & Thomas, 2006; Minogue, 2010). Ayrıca DASTT-C ölçme aracını kullanarak daha fazla sayıda katılımcıya ulaşmak mümkündür ve bu da bulguların genellenebilirliğini

arttırmaktadır. Zihinsel model analizi ışığında, hizmet içi fen bilgisi öğretmenlerinin öğrenci merkezli veya öğretmen merkezli öğretim inançları ile açık, kavramsal veya açık öğretim stillerine ilişkin öğretim tarzlarında öğretim öz-yeterliğinin önemli bir rol oynadığı sonucuna varılabilir.

Son olarak, etkili fen eğitimi için iyi hazırlanmış bir öğretim odağı gerekli olduğundan, fen bilimleri öğretmenlerinin hizmet içi dönemleri boyunca öğretme öz yeterliklerini belirlemek oldukça önemlidir (Weiss, Banilower, McMahon & Smith, 2001). Bununla birlikte, ilgili literatürün gözden geçirilmesi, öğretmen öz yeterliğinin kaynakları ve sonuçları hakkında hizmet içi fen bilgisi öğretmenleri ile yapılan mevcut araştırmaların çoğunun, fen bilgisi öğretmen adaylarına göre nispeten daha az olduğunu göstermiştir (Kıran, 2018; Kıran, 2021). Bu nedenle, çalışmanın katılımcıları olarak hizmet içi ortaokul fen bilimleri öğretmenleri tercih edilmiştir. Böylece fen bilimleri eğitiminde istenen öğretmen çıktılarını ve öğrenci çıktılarını iyileştirmek için bir adım atılacaktır.

Genel olarak, burada gözden geçirilen tüm çalışmalar, Bandura'nın dört kaynağı, iş tatmini, öğretim deneyimi ve örtük fen yeteneğine ilişkin örtük teoriler öğretme öz-yeterliği ile ilgili olduğu fikrini desteklemektedir. İlgili literatüre ve Bandura'nın önerilerine dayanarak, bu çalışma fen bilimleri öğretmenlerinin öğretim öz-yeterliklerinin kaynaklarını ve sonuçlarını analiz etmeyi amaçlamıştır. Araştırmada, fen bilimleri öğretmenlerinin öz-yeterliklerinin kaynağı olarak Bandura'nın öne sürdüğü dört kaynak, iş doyumu, öğretmenlik deneyimi ve örtük fen yeteneği teorileri incelenmiştir. Öte yandan, fen bilimleri öğretmenlerinin öğretim öz-yeterliklerinin bir sonucu olarak, öğretmen merkezli veya öğrenci merkezli gibi öğretim inançlarına ilişkin zihinsel modeller araştırılmıştır. Ayrıca, fen bilimleri öğretmenlerinin öğretim öz yeterliklerinin, öğretim stillerine (yani, keşfedici, kavramsal veya açık) ilişkin zihinsel modellerine göre farklılık gösterip göstermediği

de analiz edilmiştir. Daha spesifik olarak çalışmada aşağıda belirtilen araştırma soruları ele alınmıştır.

1. Öğretme öz-yeterliği için önerilen kaynaklar (iş tatmini, öğretim deneyimi, örtük fen yeteneğine ilişkin örtük teoriler, dolaylı deneyim, sözel ikna ve fizyolojik durumlar) hizmet içi fen bilimleri öğretmenlerinin öğretim öz yeterliliğini ne kadar iyi tahmin etmektedir?

1.1. Öğretme öz-yeterliği için önerilen kaynaklar (iş tatmini, öğretim deneyimi, örtük fen yeteneğine ilişkin örtük teoriler, dolaylı deneyim, sözel ikna ve fizyolojik durumlar) hizmet içi fen bilimleri öğretmenlerinin sınıf yönetimi için öğretim öz yeterliliğini ne kadar iyi tahmin ediyor?

1.2. Öğretme öz-yeterliği için önerilen kaynaklar (iş tatmini, öğretim deneyimi, örtük fen yeteneğine ilişkin örtük teoriler, dolaylı deneyim, sözel ikna ve fizyolojik durumlar) hizmet içi fen bilimleri öğretmenlerinin öğrenci katılımına yönelik öğretim öz yeterliliğini ne kadar iyi tahmin ediyor?

1.3. Öğretme öz-yeterliği için önerilen kaynaklar (iş tatmini, öğretim deneyimi, örtük fen yeteneğine ilişkin örtük teoriler, dolaylı deneyim, sözel ikna ve fizyolojik durumlar) hizmet içi fen bilimleri öğretmenlerinin öğretim stratejilerine yönelik öğretim öz yeterliliğini ne kadar iyi tahmin ediyor?

2. Hizmet içi fen öğretmenlerinin sınıf yönetimi, öğrenci katılımı ve öğretim stratejileri için öğretim öz yeterlikleri, öğretim inançlarına ilişkin zihinsel modellerini ne kadar iyi tahmin ediyor?

3. Hizmet içi fen öğretmenlerinin öğretim öz-yeterlikleri, öğretim stillerine ilişkin zihinsel modellerine göre farklılaşmakta mıdır?

YÖNTEM

Çalışma Deseni

Mevcut çalışmada, hizmet içi fen öğretmenlerinin öğretim öz-yeterliklerinin kaynaklarını ve sonuçlarını incelemiştir. Öğretim öz-yeterliliğinin kaynakları olarak, Bandura'nın kaynakları, öğretmenlik deneyimi, iş tatmini ve fen yeteneğine ilişkin örtük teoriler; öz-yeterlik öğretmenlerinin öğretim inançlarına ilişkin zihinsel modelleri incelenmiştir.

Katılımcılar

Bu araştırmanın evrenini, Türkiye'de Fen Bilimleri Öğretmenliği alanında çalışan öğretmenler oluşturmaktadır. Araştırmanın örneklemini ise Ankara ilinin Çankaya ve Gölbaşı ilçelerinde ortaokullarda fen bilimleri öğretmenliği branşında çalışmakta olan öğretmenler oluşturmaktadır. Örneklem seçiminde kolay ulaşılabilir durum örnekleme yöntemi kullanılmıştır.

Bu çalışmaya 154 kadın ve 38 erkek olmak üzere toplam 192 fen bilgisi öğretmeni katkıda bulunmuştur. Ortalama yaş 23 ile 65 arasında değişmektedir. Öğretmenlik deneyimleri 1 ile 35 arasında değişmektedir. Öğretmenlerin öğretmenlik deneyimi, acemi öğretmenler ve deneyimli öğretmenler olarak sınıflandırılmıştır. Arzi ve White'a (2008) göre öğretmenlik mesleğine yeni başlayan ve beş yıldan daha az öğretmenlik deneyimine sahip olan öğretmenler acemi öğretmen olarak sınıflandırılmaktadır. Beş yıllık öğretmenlik deneyiminden sonra mesleki gelişimi daha fazla olan öğretmenler deneyimli olarak sınıflandırılmaktadır (Arzi & White, 2008). Mevcut çalışmada, katılımcıların sadece % 18.20'si acemi öğretmendir.

Veri Toplama Araçları

Demografik Bilgi Ölçeği

Demografik bilgi ölçeği ile katılımcıların cinsiyet, yaş, mezun olduğu fakülte, mezun olduğu bölüm, mezuniyet derecesi, iş deneyimi, haftalık ders saati, sınıflardaki öğrenci sayısı gibi bilgileri hakkında veri toplanacaktır.

Fen Öğretimine Yönelik Çok Boyutlu Öz-yeterlilik Ölçeği

Özyeterlik Kaynakları Ölçeği, Tschanneıı-Moran and Woolfolk-Hoy (2001) tarafından öğretmenlerin özyeterlik inançlarını belirlemek amacıyla geliştirilmiştir. Öğretmenlerin öz-yeterlik inançlarını belirlemek için Tschannen-Moran ve Woolfolk Hoy (2001) tarafından geliştirilen, Çapa, Çakıroğlu ve Sarıkaya (2005) tarafından Türkçeye çevrilen "Teachers' Sense of Efficacy Scale" (TSES-Öğretmen Öz-Yeterlik Ölçeği)'nin uzun formu kullanılmıştır. Türkçeye uyarlanan ölçeğin bütününe ilişkin olarak hesaplanan Cronbach's Alpha katsayısı 0,93 alt boyutların alpha değerleri; Öğrenci katılımına yönelik öz-yeterlik: 0,82 Öğretim stratejilerine yönelik öz yeterlik: 0,86 Sınıf yönetimine yönelik öz-yeterlik: 0,84 olarak bulunmuştur.

Öz-yeterlilik Algısı Kaynakları Anketi

Özyeterlik Kaynakları Ölçeği, Kieffer ve Henson (2000) tarafından öğretmenlerin özyeterlik kaynaklarını belirlemek amacıyla geliştirilmiştir. Ölçek geliştirme aşamasında alanyazın kapsamlı bir şekilde taranmış ve Tschannen-Moran, Woolfolk Hoy ve Hoy'un (1998) ileri sürdüğü öğretmen özyeterlik modeli ve Bandura'nın

önerdiği özyeterlik kaynaklarına dayanarak maddeler oluşturulmuştur. Ölçekte "benim için kesinlikle doğru değil"den (1) "benim için kesinlikle doğru"ya (7) değişen 7'li derecelendirme kullanılmıştır. Ölçekte yer alan boyutlar ve her boyuttaki madde sayısı şunlardır: doğrudan yaşantılar (9 madde), dolaylı yaşantılar (9 madde), sözel ikna (10 madde) ve fizyolojik ve duygusal durumlar (7 madde). Boyutlara ait güvenirlik katsayıları sırasıyla 0,71, 0,78, 0,45 ve 0,60 olarak raporlanmıştır (Kieffer ve Henson, 2000).

İş Tatmini Ölçeği

İş tatmini ölçeği Skaalvik ve Skaalvik (2009) tarafından öğretmenlerin iş doyumu hakkında bilgi toplamak adına geliştirilmiştir. Yerdelen (2013) tarafından Türkçe'ye uyarlanmış ve güvenilirlik katsayısı 0.87 olarak tayin etmiştir. Ölçeğe ilişkin örnek maddeler: Eğer bugün mesleğinizi seçme şansınız olsaydı, öğretmen olmayı seçer miydiniz?, Mesleğinizi tüm yönleriyle ele aldığınızda, öğretmen olarak çalışmaktan ne kadar zevk alıyorsunuz?

Fen Yeteneğine İlişkin İnançlar Ölçeği

Fen Yeteneğine İlişkin İnançlar Ölçeği Dweck and Leggnett (1998) tarafından geliştirilmiştir. Yerdelen (2013) tarafından Türkçe'ye uyarlanmış ve güvenilirlik katsayısı 0.84 olarak tayin etmiştir. Ölçeğe ilişkin örnek maddeler: Kişiler fen bilimleri konularında yeni bir şeyler öğrenebilir fakat, fen bilimlerine yönelik temel yeteneklerini değiştiremezler. Kişiler fen bilimlerine yönelik belirli bir yeteneğe sahiptir ve bunu değiştirmek için pek bir şey yapmazlar.

Fen Öğretmeni Çizim Testi-Kontrol Listesi (DASTT-C)

Thomas, Pedersen ve Finson (2001) tarafından geliştirilmiş test, öğretmen adaylarının (a) kendilerini bir öğretmen olarak resmetmelerini, (b) kendilerini bir öğretim süreci içine yerleştirmelerini, (c) fen öğretimine yönelik zihinsel modellerini ortaya koymalarını amaçlamaktadır. Testte öğretmen, öğrenci ve çevre olmak üzere üç puanlama bölümü bulunmaktadır. Öğretmen bölümü kendi içinde "öğretmenin etkinliği" (gösterip yaptırma, düz anlatım, görsel araçlar kullanma vb.) ve "öğretmenin duruşu" (öğrencilere göre öğretmenin duruşu örneğin sınıfın önünde durması vb.) olmak üzere iki alt bölümden oluşmaktadır. Öğrenciler bölümü de öğretmen bölümü gibi "öğrencinin etkinliği" ve "öğrencinin duruşu" iki alt bölümünden oluşmaktadır. Üçüncü bölüm ise sıralar, öğretimin sembolleri (örneğin tahta vb.) sınıf içinde bulunan bileşenlerden oluşmaktadır. Testin KR-20 güvenirlik katsayısı olarak 0.74 hesaplanmıştır.

Veri Analizi

Bu çalışmada tanımlayıcı ve çıkarımsal istatistiksel analizler “SPSS 15” yazılım programı kullanılarak yapılmıştır. Toplanan veriler ön analiz, tanımlayıcı ve çıkarımsal istatistikler kullanılarak analiz edilmiştir. Ön analiz olarak veri temizleme, aykırı değer ve varsayım kontrolleri yapılmıştır. Tanımlayıcı istatistikler kapsamında fen bilimleri öğretmenlerinin demografik bilgilerini belirlemek için ortalama, standart sapma, çarpıklık ve basıklık vb. hesaplanmıştır. Çıkarımsal istatistikler için çoklu regresyon analizi ve çok değişkenli varyans analizi (MANOVA) teknikleri kullanıldı. Önerilen kaynakların öğretmenlerin öz-yeterlik duygusunu ne kadar iyi öngördüğünü incelemek için çoklu regresyon analizi kullanıldı ve ayrıca öğretmenlerin öz-yeterlik duygusunun öğretmenlerin öğrenci merkezli öğretim inançlarını ne kadar iyi öngördüğünü araştırmak için kullanıldı. Ayrıca, hizmet içi fen bilimleri öğretmenlerinin öğretim öz yeterliklerinin öğretim

stillerine göre farklılaşıp farklılaşmadığını incelemek için yine çok değişkenli varyans analizi (MANOVA) yapılmıştır.

BULGULAR VE TARTIŞMA

Bu çalışmada ilk olarak, öğretim öz-yeterliği için önerilen kaynakların, hizmet içi fen bilimleri öğretmenlerinin öğretim öz-yeterliliğini öğrenci katılımı, öğretim stratejileri ve sınıf yönetimi açısından ne kadar iyi öngördüğünü araştırıldı. Hizmet içi fen bilimleri öğretmenlerinin öğretim öz-yeterliğini öğrenci katılımı alt boyutuna ilişkin çoklu regresyon analizi sonuçları, doğrudan yaşantıların ($\beta = .37$), fizyolojik ve duygusal durumların ($\beta = -.24$) ve örtük öğrenme inancının etkili olduğunu ortaya koymuştur. Daha spesifik olarak, hizmet içi fen öğretmenlerinin uzmanlık deneyimlerinin, öğrenci katılımı için öz yeterliklerini olumlu bir şekilde yordadığı bulunmuştur. Başka bir deyişle, hizmet içi fen öğretmenlerinin doğrudan deneyimi arttıkça, öğrenci katılımı için öğretim öz yeterlikleri de artmaktadır. Bununla birlikte, fizyolojik ve duygusal durumlar, fen bilimleri öğretmenlerinin öğrenci katılımı için öz yeterliklerini olumsuz yönde yordamıştır. Bu, hizmet içi fen öğretmenlerinin ders saatlerinde kaygı, korku veya gerginlik arttıkça, öğrenci katılımı için öz yeterliklerinin düşme olasılığının daha yüksek olduğu anlamına gelir. Benzer bir bağlamda Kıran (2021), doğrudan yaşantıların öğrenci katılımı için öğretim öz-yeterliğinin en güçlü kaynağı olduğunu, fizyolojik ve duygusal durumların ise olumsuz bir yordayıcı olduğunu bulmuştur. Buna ek olarak, mevcut çalışmada, öğretmenlerin fen yeteneğine ilişkin örtük teorilerinin öğrenci katılımı için öz-yeterliklerinin pozitif bir yordayıcısı olduğu bulunmuştur, bu da öğrencilerin fen becerisinin sabit olmadığına inanan öğretmenlerin daha yüksek öz-yeterliğe sahip olma eğiliminde olduklarını ima etmektedir. Bu sonuç literatür bulguları ile uyumludur; örneğin, Palazzolo (2016), öğrenci katılımı için üst düzey öğretmen öz-yeterliği ile artan bir bilim yeteneği görüşü arasında anlamlı bir pozitif ilişki bulmuştur. Öte yandan, bu çalışmada, dolaylı yaşantılar, sözel ikna, iş doyumu ve

öğretmenlik deneyimi, öğretmen öz yeterliğinin öğrenci katılımı için anlamlı yordayıcıları olarak bulunmamıştır.

Sınıf yönetimine yönelik öz-yeterlik alt boyutu için de aynı sonuçlar elde edilmiştir. Daha spesifik olarak, çoklu regresyon sonuçları doğrudan yaşantıların (β = .36) ve fen yeteneğine ilişkin örtük teorilerinin (β = .18) anlamlı pozitif yordayıcı olduğunu, fizyolojik ve duygusal durumların (β = -.19) ise sınıf yönetimine yönelik öz-yeterlik alt boyutu için anlamlı negatif yordayıcı olduğunu göstermiştir. Bu sonuçlar ilgili alan yazındaki bulgularla da uyumludur (Hoy & Spero, 2005; Kıran, 2021; Klassen & Chiu, 2010; Palazzolo, 2016; Palmer, 2006; Tchannen-Moran & Hoy, 2007).

Öğretim stratejilerine yönelik öz-yeterlik alt boyutunda da benzer sonuçlar elde edilmiştir. Spesifik olarak, doğrudan yaşantılar (β = .41) ve fen yeteneğine ilişkin örtük teoriler (β = .23) anlamlı pozitif yordayıcı olarak bulunmuştur. Ancak bu boyut için sadece fizyolojik ve duygusal durumlar (β =- .21) değil aynı zamanda dolaylı yaşantı (β = -.28) olumsuz bir yordayıcı olarak bulunmuştur. Dolaylı yaşantılarla ilgili negatif sonuç bulunması, model öğretmen iyi performans gösterdikçe araştırmaya katılan öğretmenlerin öğretim öz-yeterlik öğretim stratejilerinin azalttığını ima etmektedir. Birçok araştırmacı dolaylı deneyimi öğretmenlik öz-yeterliğinin olumlu bir yordayıcısı olarak bulsa da, Bandura (1997) dolaylı yaşantıların öğretme öz-yeterliğini artırabileceğini veya azaltabileceğini belirtmiştir. Literatürde dolaylı yaşantıların öğretme öz yeterliliğini azalttığına ilişkin mevcut bulguyu destekleyen çalışmalar bulunmaktadır (Paulou, 2007; Sahranç, 2007). İlgili literatüre göre, okul atmosferi ve yapısı gibi okul düzeyindeki değişkenler de öğretmenlerin öğretim öz-yeterlik inançlarını etkileyebilir. Örneğin, okul iklimini olumlu algılayan öğretmenlerin daha güçlü öğretim öz-yeterlik inançlarına sahip oldukları bulunmuştur (Moore & Esselman, 1992). Ayrıca öğretmen performansı hakkında olumlu geribildirim almanın ve diğer öğretmenlerle işbirliği yapmanın öğretmenlerin öğretme öz-yeterliliği ile önemli ölçüde ilişkili olduğu belirtilmiştir

(Rosenholtz, 1989). Buna göre araştırmanın yapıldığı okullarda okul kültürünün ve öğretmenlerin kendi aralarındaki iletişiminin detaylı bir şekilde incelenmesine ihtiyaç olduğu düşünülmektedir. Okullarda öğretmenler arası işbirliği yeterince desteklenmiyorsa ve rekabet ortamı varsa, bir öğretmenin öğretim stratejileri açısından örnek teşkil edebilecek uygulamaları diğer öğretmenler üzerinde baskı oluşturabilir. Sonuç olarak, öğretim stratejilerine yönelik öğretme öz yeterliklerinde bir azalma olabilir. Bununla birlikte, dolaylı deneyim ile öğretim stratejileri için öğretim öz yeterliliği arasındaki olumsuz ilişki için bu olası açıklama spekülatiftir ve daha fazla araştırmayı garanti etmektedir. Literatüre göre öğretmenler, özellikle sınırlı geçmiş deneyimlere sahip olduklarında, dolaylı deneyimler yoluyla öz-yeterliklerini geliştirebilirler (Bandura, 1997; Mohamadi & Asadzadeh, 2011; Schunk, 2004). Ayrıca, Tchannen-Moran ve Hoy (2007), Bandura'nın kaynakları arasında sözel ikna ve dolaylı deneyimin, deneyimli öğretmenlerden ziyade önemli bir uzmanlık deneyimine sahip olmayan öğretmen adayları ve acemi öğretmen adayları için öğretme öz yeterliğinin en belirgin yordayıcıları olabileceğini belirtmişlerdir. Bu çalışmada, katılımcıların çoğu beş yıldan fazla öğretmenlik deneyimine sahip deneyimli öğretmenlerdir. Dolayısıyla, söz konusu literatüre dayalı olarak, dolaylı deneyimin öğretim öz-yeterliğinin anlamlı bir yordayıcısı olmadığı beklenen bir bulgudur.

Ayrıca fen yeteneğine ilişkin örtük teoriler, öğretme öz-yeterliğinin tüm alt boyutlarıyla pozitif ve anlamlı bir şekilde ilişkili olduğu bulunmuştur. Bu sonuç, bireylerin fen becerilerinin esnek olduğuna inanan öğretmenlerin daha yüksek öz-yeterliğe sahip olma eğiliminde olduklarını göstermiştir. Bu sonuçlar ilgili literatürdeki bulgularla uyumludur (Deemer 2004, Lee 1996, Palazzola, 2016; Sarazzin vd., 2007; Tamir vd., 2007, Yerdelen 2013). Örneğin, benzer bir bağlamda McWilliams (2012) öğretmenlerin örtük teorileri ile öğretme öz-yeterliği arasındaki ilişkiyi incelemiştir. McWilliams (2012) öğretmenlerin artımlı teoriye eğilimleri arttıkça öğretme öz yeterliklerinin arttığını bulmuştur. Feldstein (2017) , acemi öğretmenlerin örtük teorileri ile öğretme öz yeterliklerinin yüksek oranda ilişkili

olduğunu ve bu ilişkinin onların meslekte kalma niyetlerini etkilediğini bulmuştur. İlgili literatüre göre öğretmenlerin öğretim öz-yeterlik ve örtük yetenek inançları sınıf uygulamalarında önemli bir rol oynamaktadır.

Öte yandan öğretmenlerin deneyimlerinin öğretmenlik öz-yeterlik alt boyutlarından herhangi birinin anlamlı bir yordayıcısı olmadığı görülmüştür. Öğretmenlerin yıllara dayanan deneyimleri ile ilgili olarak, ilgili literatür çoğunlukla tutarsız sonuçlara işaret etmektedir. Diğer bir deyişle, örneğin bazı araştırmacılar, öğretmenlerin deneyim yılları ile üç öz yeterlik boyutunun tümü arasında, kariyerin başlangıcından kariyerin ortasına kadar yükselen ve sonrasında azalan doğrusal olmayan bir ilişki bulmuşlardır (Klassen & Chiu, 2010; Soodak & Podell, 1997; Woolfolk Hoy & Burke Spero, 2005). Tschannen-Moran ve Woolfolk Hoy, 2001 tarafından yürütülen bir başka çalışmada, öğretmenlerin öğretmenlik yılları öğretim stratejileri ve sınıf yönetimi için öğretme öz yeterliği üzerinde orta düzeyde etkiye sahiptir, ancak öğrenci katılımı için öğretmen öz yeterliliği üzerinde hiçbir etkisi yoktur. Diğer araştırmacılar, öğretmenlik öz-yeterliğinin yıllarca öğretmenlik deneyimi ile pozitif ilişkili olduğunu belirtmişlerdir (Hoy & Woolfolk, 1993; Campbell, 1996). Bununla birlikte, mevcut çalışma sonuçları, öğretmenlik deneyimi yıllarının, öğretmenlerin öğretim öz yeterliklerinin üç alt boyutunda anlamlı olmayan bir yordayıcı olduğunu göstermektedir. Ancak literatürde bu bulguyu destekleyen çalışmalar bulunmaktadır (Cheung, 2007; Ross vd., 1996; Tschannen-Moran & Johnson, 2011; Wolters & Dougherty, 2007). Ayrıca, Bandura (1997), öz-yeterlik inançlarının öğretimin başlarında en çok değişkenlik gösterdiğini ve bir kez kurulduktan sonra nispeten istikrarlı hale gelme ve değişime direnme eğiliminde olduğunu ileri sürmüştür. Tschannen-Moran ve Hoy (2007), öğretmenlik deneyimi öğretme öz-yeterliliğini öngörebilir gibi görünebilir, ancak eğer öz-yeterlik bir kez belirlendikten sonra değişime direnme eğilimindeyse, o zaman öğretim öz-yeterliliği öğretim deneyimi arttıkça artmaya meyilli olmayabileceğini ortaya koymuştur.

İş doyumu da tüm alt boyutlar için öğretmenlik öz yeterliğinin anlamlı olmayan bir yordayıcısıdır. Mevcut çalışma ile benzer bir bağlamda, Demirdağ (2015) da genel iş tatmini ile öğretmen özyeterliği arasında bir ilişki bulamamıştır. Ancak alan yazın incelendiğinde genel olarak bu sonuç, iş tatmini ile öz-yeterlik arasında pozitif bir ilişki olduğunu gösteren önceki bulgularla uyumlu değildir (Klassen & Chiu, 2010; Turkoglu vd., 2017). Örneğin, Türkoğlu et al. (2017) ilkokul, ortaokul ve lise öğretmenleri ile yaptıkları çalışmada iş doyumunun öğretmen özyeterliği için anlamlı bir yordayıcı olduğu ortaya çıkmıştır. Aslında, iş tatmini genellikle öğretmenlerin motivasyonunu ve performansını geliştirmek için belirleyici bir faktör olarak görülmüştür. Caprara ve arkadaşlarına (2006) göre, öğretmenlerin en önemli öğretim öz-yeterlik kaynağı ve öğretmenlerin doğrudan deneyimleri, başarılı geçmiş deneyimlerinden beslenir. Öğretmenlerin geçmişteki olumlu deneyimleri, içsel ve dışsal ödüller sunarak iş doyumlarını artırabilir ve bu da öğretim öz yeterliklerini geliştirebilir. Bu prosedür, iş tatmini gibi olumlu duyuşsal faktörlerin öğretim öz-yeterliliğinin bir kaynağı olabileceğini öne süren sosyal-bilişsel teori (Bandura, 1997) ile tutarlı olacaktır. Bu nedenle, mevcut çalışma sonuçları, iş tatminini öğretme öz yeterliliğinin olumlu bir yordayıcısı olarak beklemektedir, ancak sonuçlar bunu desteklememektedir. Ancak bu noktada şunu belirtmek gerekir ki, bu çalışmada öğretmenlik öz-yeterliği ile iş doyumu arasındaki doğrudan ilişki analiz edilmiştir. Ancak bu ilişkiyi sağlayan aracı veya düzenleyici faktörler olabilir. Örneğin, yetersiz çalışma koşulları, derse hazırlanmak için kısıtlı zaman, çalışma saatleri nedeniyle oluşan iş stresi, öğretme öz yeterliliği ile iş doyumu arasında bir aracıdır (Troesch & Bauer, 2017). Daha ileri çalışmalar, önerilen ilişkilendirmeyi etkileyen moderatör faktörleri de dikkate almalıdır.

Özetle, birinci soruya ilişkin sonuçlar, doğrudan yaşantıların en önemli yordayıcı olduğunu, örtük fen kuramı yeteneğinin ikinci anlamlı olumlu yordayıcı olduğunu ve fizyolojik ve duygusal durumların hizmet içi fen bilimleri öğretmenlerinin kendi kendine öğretmelerinin önemli bir olumsuz yordayıcısı olduğunu göstermektedir. Önerilen öğretim öz-yeterliliği kaynakları arasında, iş tatmini, yıllarca öğretmenlik

deneyimi ve sözel ikna, istatistiksel olarak anlamlı yordayıcı olarak bulunmamıştır. İlgili literatüre göre, deneyimli öğretmenler arasında öğretme öz-yeterliğinin bir yordayıcısı olarak önerilen bu kaynakların eksikliği, doğrudan yaşantılarının birikimi ile diğer kaynakların öğretme öz-yeterliliğini geliştirmede daha az önemli bir rol oynadığını gösterebilir (Tschannen-Moran). & Hoy, 2007). Diğer bir deyişle, doğrudan yaşantılar kaynağı, en güçlü yordayıcı olduğu için öğretmenlerin öğretme öz-yeterlik inancının oluşmasında daha önemli bir rol oynayacaktır. Öte yandan, diğer kaynaklar, beş yıldan daha az öğretmenlik deneyimine sahip olan acemi öğretmenler için, geçmiş deneyimleri az olduğu için daha belirgin olacaktır (Tschannen-Moran & Hoy, 2007). Bu nedenle, mevcut çalışma sonuçları, katılımcıların acemi öğretmenlerden ziyade deneyimli öğretmenler olması nedeniyle literatürle birlikte beklenen sonuçlar olarak değerlendirilebilir.

İkinci olarak, bu çalışma öğretmenlerin öğretme öz-yeterliği ile bunun sonucu arasındaki ilişkiyi de araştırmıştır. Sonuç olarak, hizmet içi fen öğretmenlerinin öğretmen merkezli veya öğrenci merkezli öğretim inançlarına ilişkin zihinsel modelleri incelenmiştir. Çoklu regresyon analizlerine göre, öğretim öz-yeterlik alt boyutlarının kombinasyonunun ortaokul fen bilimleri öğretmenlerinin öğretme inançları ile önemli ölçüde ilişkili olduğunu bulunumştur. Ancak sınıf yönetimi için öğretme öz-yeterliği, öğrenci katılımı için öğretme öz-yeterliği ve öğretim stratejileri için öğretme öz-yeterliği olmak üzere her bir alt boyutun kendine özgü katkıları istatistiksel olarak anlamlı değildir. Bu çalışmada öğretmenlerin öğretme öz-yeterlik alt boyutları öğretmenlerin öğretme inançlarına ilişkin zihinsel modellerinin anlamlı yordayıcıları olarak bulunmamakla birlikte, ilgili literatürde bazı araştırmalarda anlamlı ilişki bulunmuştur (Finson vd., 2006; Tartar vd., 2012; Thomas vd., 2001). Mevcut bulgular, mevcut yordayıcıların dışında, öğretmenlerin öğretme inançlarına ilişkin zihinsel modellerini açıklayan başka değişkenlerin olabileceğini düşündürebilir. Gelecekteki çalışmalar bu öneriyi dikkate alabilir; örneğin, bu çalışmada öğretim öz yeterlik kaynağı olarak kullanılan değişkenlerin öğretmenlerin öğretim inançlarına ilişkin zihinsel modelleri ile doğrudan ilişkileri incelenebilir.

Son olarak, mevcut çalışma, hizmet içi fen öğretmenlerinin öğretim stillerine ilişkin keşfedici, kavramsal ve açık zihinsel modellerinin sınıf yönetimi, öğrenci katılımı ve öğretim stratejileri alt boyutlarına yönelik öğretim öz-yeterlikleri açısından farklılık gösterip göstermediğini incelemiştir. Çok değişkenli test analizine (MANOVA) göre öğretmen öz-yeterlik alt boyutlarının birleşimi açısından hizmet içi fen bilgisi öğretmenleri öğretim stilleri arasında anlamlı bir farklılık bulunmuştur. Ayrıca, hizmet içi fen öğretmenlerinin öğrenci katılımı için öğretme öz yeterlikleri ve ayrıca öğretim stratejileri öğretim stillerine göre farklılık göstermektedir. Gerçekten de, keşfedici öğretim stillerine sahip öğretmenler, açık öğretim stilleri olan öğretmenlere göre öğrenci katılımı ve öğretim stratejileri için daha yüksek öğretim öz-yeterliğine sahip olma eğilimindedir. Başka bir deyişle, keşfedici öğretim stiline sahip öğretmenler, açık öğretim stiline sahip öğretmenlere kıyasla, öğrencileri fen eğitimine dahil etme ve uygun öğretim stratejilerini uygulama konusunda yüksek bir yeteneğe sahiptir. Ayrıca, DASST-C geliştiricilerine göre Thomas ve arkadaşları (2001), keşfedici öğretim stiline sahip öğretmenlerin öğrenci merkezli öğretim stratejilerini uygulama olasılığı daha yüksekken, açık öğretim stiline sahip öğretmenler öğretmen merkezli öğretim yöntemlerini uygulama eğilimindedir. Ek olarak, keşfedici öğretim stiline sahip öğretmenler, öğrencileri bireysel veya grup çalışması içinde yeni kavramları araştırmaya dahil etme, öğrencilerin problemlerini çözme, düşünme ve yenilikçilik becerilerini geliştirme ve öğrencilerinin seçimlerine daha fazla dikkat çekme eğilimindedir. Dolayısıyla mevcut bulgular mevcut literatüre dayalı olarak beklendiği gibi bulunmuştur (Rubeck & Enochs 1990; Finson vd., 2006; Finson vd., 2000).

ÖNERİLER

Bu araştırma, ortaokul fen bilimleri öğretmenlerinin öğretim öz-yeterlik inançlarının kaynakları ve sonuçları arasındaki ilişkiyi incelemiştir. Mevcut çalışmanın sonuçları ışığında, hizmet içi fen bilgisi öğretmenlerinin, öğretmenlik öz-yeterliklerini, fizyolojik ve duygusal durumları ve fen yeteneğine ilişkin örtük inançları geliştirmek için öncelikle doğrudan deneyimlerinden yararlandıkları sonucuna varılabilir. Öğretmenlik öz-yeterliği öğretmenlik kariyerlerinde erken gelişmeye başlar ve hatta hizmet öncesi öğretmenlik döneminde ilk adımlarını atar. Alınyazında öğretmen adaylarının öğretmenlik öz yeterlik inançlarını inceleyen çeşitli araştırmalar bulunmaktadır (Kıran, 2021). Bu nedenle, öğretmen öz-yeterlik inançları hizmet öncesi ve erken öğretim yıllarında daha esnek olduğundan (Hoy & Spero, 2005), öğretmen adaylarının daha doğrudan deneyim kazandıkları staj derslerine ve öğretmen yetiştirme programlarında daha fazla önem verilmesi önerilmektedir. Bu uygulama aynı zamanda hizmet içi fen öğretmenlerine kendi doğrudan deneyimlerini gözden geçirmeleri için avantajlar sunar.

Sonuçlara göre, fen yeteneğine ilişkin örtük inançları, öğrenci katılımı, sınıf yönetimi ve öğretim stratejileri için öğretim öz-yeterliğini geliştirmeye katkıda bulunan önemli bir yordayıcı olduğu bulunmuştur. Okul bağlamında, yüksek düzeyde öz-yeterliğe sahip öğretmen adayları, öğrencilerin fen öğrenme yeteneğinin şekillendirilebilir olduğuna ve böylece öğrencilerin bilgilerini artırabileceğine inanabilirler. Öte yandan, düşük öğretme öz-yeterliğine sahip varlık öğretmenleri, öğrencilerin fen yeteneklerinin sabit olduğuna ve değiştiremeyeceğine inanabilirler. Öğrencilerin yetenekleri hakkında artırımsal bir teoriye sahip olmanın, öğretim uygulamalarına ilişkin olumlu okul uygulamaları sağlayacağını belirtmek önemlidir (Pintrich & Schunk, 2002). Bu nedenle, okul ilkelerinin tüm öğretmenler arasında, öğrencilerin yeteneklerini geliştirebilecekleri konusunda ortak bir inanç oluşturması

önerilmektedir. Fen bilimleri öğretmenlerinin de aynı şekilde tüm öğrencilerinden fen becerileri konusunda yüksek beklentiye sahip olabilirler.

Ek olarak, sonuçlar ayrıca hizmet içi fen bilimleri öğretmenlerinin kaygı, korku veya gerginliğin arttığını, öğretim öz yeterliklerinin azaldığını göstermektedir. Bu nedenle öğretmenler stres yönetimi konulu bir çalıştaya katılabilirler. İş stresiyle nasıl başa çıkılacağını bilmek, öğretmeye yönelik öğretim öz yeterliliğini artırmaya yardımcı olacaktır. Bu şekilde öğretmenler fizyolojik ve duygusal durumlarını kontrol etme konusunda kendilerine güven duyarlar ve sınıf yönetimi, öğrenci katılımı ve öğretime odaklanabilirler.

Ayrıca, hizmet içi fen bilimleri öğretmenleri, öğretim stratejileri için öz-yeterlik öğretme kaynağı olarak dolaylı deneyimleri de kullanıyorlar. Sonuçlar, model öğretmenler iyi performans gösterdikçe katılımcı öğretmenlerin öğretim stratejilerine yönelik öz yeterliklerinin azaldığını göstermektedir. Bu azalmanın önüne geçebilmek için, hizmet içi fen bilimleri öğretmenleri, Milli Eğitim Bakanlığı Öğretmen Yetiştirme ve Geliştirme Genel Müdürlüğü tarafından geliştirilen hizmet içi eğitim programı kurslarına katılabilirler. Bu kurslar, farklı okullardan öğretmenlerin öğrenme ortamında nasıl ve hangi öğretim yöntemlerinin uygulandığına ilişkin deneyimlerini paylaşmalarına olanak tanır. Ayrıca bu kurslar, katılımcıların STEM eğitimi, ters yüz öğrenme sınıf uygulamaları, okul dışı öğrenme, robotik kodlama, hikaye anlatımı gibi konularda disiplinler arası bir ekiple çalışmasına da olanak tanır. Ayrıca Milli Eğitim Bakanlığı Öğretmen Yetiştirme ve Geliştirme Genel Müdürlüğü tarafından araştırma-sorgulamaya dayalı fen eğitimi, eleştirel düşünme, yenilikçi düşünme, işbirliği ve yeterlilik geliştirme, etkinlik temelli ders planı tasarımı, doğa eğitiminde kök uygulamaları gibi atölye çalışmaları ve seminerler de verilmektedir. Öğretmenler bu tür eğitimlere katılarak mesleki yeterliliklerini güncelleyebilirler.