International Journal of Contemporary Educational Research (IJCER)

www.ijcer.net

Exploration of Pre-Service Science Teachers' Perceptions towards Secondary School Science Curriculum

Gökhan Aksoy[1]
[1]Inonu University

To cite this article:

Aksoy, G. (2019). Exploration of pre-service science teachers' perceptions towards secondary school science curriculum. *International Journal of Contemporary Educational Research, 6*(1), 11-28. DOI: https://doi.org/10.33200/ijcer.543360

International Journal of Contemporary Educational Research
Volume 6, Number 1, June 2019, 11-28 ISSN: 2148-3868

Exploration of Pre-Service Science Teachers' Perceptions towards Secondary School Science Curriculum

Gökhan Aksoy[1*]
[1]Inonu University

Abstract

This study aims to put forth how and to what degree pre-service science teachers can practice 2018 Secondary School Science Curriculum (SSSC). The study employs an illustrative case study design. Identified through purposive sampling, the participants of the study consist of 28 senior pre-service teachers studying at science teaching program at an education faculty. Document analysis, semi-structured observation form and researcher's journal were used as data collection tools. The data were analyzed through descriptive analysis. The findings of the study reveal that there are some mismatches between the contents of 2018 SSSC and prospective teachers' practices. It was found out that prospective teachers have deficiencies in the areas of using materials that fit with subjects, using evaluation methods in line with learning outcomes, making use of instructional technologies, knowledge of instructional approaches, methods and techniques, and stating lesson plan clearly. On the other hand, the pre-service teachers have positive behaviours regarding relating the subject with previous and subsequent lessons, securing the learning environment, relating the subject with other subjects in the field and knowledge of basic concepts of the subject.

Key words: Pre-service science teachers, intended curriculum, enacted curriculum, general competencies for teaching profession

Introduction

Countries possessing contemporary education systems are getting independent with respect to technology, military and economy, and become self-sufficient. Undoubtedly, science education has a significant role in countries' reaching this position. Countries that are aware of this role focus their attention on education of science and its related disciplines. Kelly (2002) argues that ministries of education across the world are carrying out concrete endeavors by meticulously examining the quality of schools' science curricula and comparing their success in science with the world. As in the rest of the world, these endeavors are conducted in Turkey in an extremely reformist way. It is very important for Turkey to maximize its international success in science in the ranking of developing countries. There are approximately 18 million students in Turkey and about five million of these students are at secondary school level. This paramount number of students is bigger than the population of 143 countries in the world (Emin, 2018). Beside the number of students, Ministry of National Education (MoNE) (2019) reports that there are about one million teachers working in formal education institutions. Considering the massive number of students and teachers in Turkey, the expanse of the universe in variables of environment, school, class, and family conditions unfold. MoNE frequently revises curricula in accordance with needs out of national and international reasons. Therefore, it can be suggested that Turkey is doing its best to maximize the efficiency of its potential power.

Revision endeavors in science education in Turkey mainly include revisions in science curricula carried out by MoNE and revisions in general competencies for teaching profession (GCTP) defined again by MoNE. Regarding that these revision endeavors are enlightening for the state of science education in Turkey, they are explained in the current study respectively.

* Corresponding Author: *Gökhan Aksoy, aksoygok44@gmail.com*

Revisions in Secondary Schools Science Curriculum in Turkey

In last 15 years, MoNE revised secondary school science curriculum (SSSC) in 2005, 2013 and 2018 (MoNE, 2017b). As of 2005-2006 academic year, Turkey has restructured its formal education system (particularly primary and secondary schools). The Science and Technology curriculum prepared in 2005 aimed students to attain science literacy. MoNE centered progressivist education philosophy and constructivist learning theory in 2005 science and technology curriculum. This curriculum was based on student-centred, spiral and modular curriculum designs. Approaches, methods or techniques such as cooperative learning, multiple intelligence, project-based learning, problem solving, modelling, brain storming, six thinking hats were highlighted. The 2005 curriculum aimed to equip students with scientific research skills, creative thinking, critical thinking, communication skills, entrepreneurship and ability to use information and communication technologies (Ayas & Çepni, 2016; Topsakal, 2006).

In 2012-2013 academic year, eight-year continuous and compulsory basic education was abolished, and it was transferred to a twelve-year gradual and compulsory education system designed as 4+4+4 blocks. The first four years is designed as primary school, the second four year is designed as secondary school and the last four years is designed as high school. With the change in the education system, it was mandatory to revise the curricula in order to meet the needs of the new system. Accordingly, the 2005 science and technology curriculum was revised in 2013, named as Science (Physical sciences) Curriculum. Student-centred methods were also adopted in 2013 science curriculum. In this new curriculum, methods based particularly on research questioning and argumentation method were featured. Use of technology in the assessment of students' performance was also highlighted (Eskicumalı, Demirtaş, Erdoğan, & Arslan, 2014). Besides, socio-scientific contents were also included in science curriculum as of 2013 (Hastürk, 2017).

Following the revision in 2013, science curriculum was revised in 2018 again after a pilot study with fifth graders in 2017 in accordance with analysis of success in science in international student assessments such as TIMMS and PISA (PISA, 2015; TIMSS, 2015), and feedback from other stakeholders of education. In 2018 science curriculum, the contents in secondary school has been downsized. Explanations of most of the units were simplified and the units were re-ordered. The contents of students' learning outcomes were also simplified, and clear statements were chosen (Bahar, Yener, Yilmaz, Emen, & Gürer, 2018). In 2018 secondary school science curriculum (SSSC), it was aimed to equip students with competencies such as digital competency, learning to learn and competency in science/technologies. In 2018 SSSC, 'value education', which enables students to be good citizens, is highlighted and learning outcomes featuring ethical values and social values are included. Skill and process-based approach is given prominence in assessment and evaluation part of the curriculum. It is also aimed to develop students' written and oral communication skills. Most importantly, content area of the curriculum has increased from four to five and by this means "Science, Engineering and Entrepreneurship Practices" has been introduced to curriculum comprising 48 hours of a total of 576 hours of secondary school science lessons (grades 5,6,7,8). This accounts for about 8.3% of the total number of lesson hours in secondary school. In 2018 SSSC, practices such as product design, case study, design-based science instruction, STEM practices, innovative thinking skills are adopted (MoNE, 2018b).

As mentioned above, MoNE continuously updates curricula; however, no matter how perfect a curriculum is developed, it would not be valid if not practiced in the class as prepared on paper. The literature suggests that although science curricula theoretically include principles, methods and techniques of contemporary education, there are problems in transferring these to students in practice in class. In some studies, it was put forth that intended science curriculum did not fit with the science curriculum as perceived by teachers and the reason for this was that teachers could not perceive constructivist elements in the curriculum adequately and teachers could not internalize science curriculum (Atila, 2012). The findings in the literature also reveal that in crowded classes, it is hard to practice student-centred methods in the new curriculum (Karaman & Karaman, 2016), and physical characteristics of schools are not convenient for practicing new curricula (Yazıcı & Özmen, 2015). The literature also includes the findings that teachers are not adequately knowledgeable in alternative techniques featured in the revised curricula (Büyüktokatli & Bayraktar, 2014; Sağlam-Arslan, Devecioğlu-Kaymakçı, & Arslan, 2009), teachers have difficulty in providing feedback appropriately to students (Bayrak & Doğan, 2018), teachers do not carry out the necessary self-assessment in teaching-learning activities while practicing the curriculum (Uzal, Erdem, & Ersoy, 2015), some teachers resist the changes in the new curricula and do not abandon their traditional instruction habits (Hằng, Bulte, & Pilot, 2017; Tekbıyık & Akdeniz, 2008). It is also put forth that teachers have problems with respect to materials in the new curricula, schools do not have the necessary materials, and therefore teachers cannot offer an interactive education to students (Arias, Bismack, Davis, & Palincsar, 2016). In line with this, teachers have problems with teaching students the needed design skills (Delen & Uzun, 2018). A review of literature point up to the mismatch between the science curriculum

intended by MoNE and the science curriculum enacted by teachers due to the fact that teachers are not sufficient with respect to practicing constructivist elements in the curriculum (Atila, 2012). Some other studies suggest that although teachers need to grasp students' attention and meet their needs (Newton, 1988), it is observed that they are not aware of the expectations of the society (Stuckey, Hofstein, Mamlok-Naaman, & Eilks, 2013).

Changes in General Competencies for Teaching Profession (GCTP) in Turkey

Science is one of the primary courses in secondary schools in which students learn natural events in their surroundings, scientific developments, basic concepts, principles and generalizations and thereby attain the skills of thinking through scientific method process and problem solving. Teachers' support is an important dimension of learning settings in science courses (Tas, 2016), because the quality of educational services is up to the skills of teachers who practice these services. An education model cannot provide services beyond the quality of the staff practicing that model. A school can only be as good as its teachers (Kavcar, 1987). The competencies prepared by MoNE urge upon the concept of "qualified teacher". Some studies argue that teachers feel themselves insufficient in teaching activities and they are at the top level of professional burnout (Talışık, 2016). It is apparent that a teacher who feels oneself inadequate in practicing one's profession will absolutely be unsuccessful (Deniz & Tican, 2017). Kavcar (1987) defines teachers who lack subject matter knowledge as "one who does not know cannot teach" and teachers who lack pedagogical content knowledge as "not all knowers can teach". In this context, teachers who train the individuals of the future need to be equipped sufficiently. It is very important for teachers to be knowledgeable in their field of teaching and be able to transfer what they know to their students. There are a number of mismatches between the teacher competencies prepared by MoNE and practicing teachers' competencies (Baskan, Aydın, & Madden, 2006; Filiz & Aydın, 2018).

MoNE has revised general competencies for teaching profession in line with reflections of national and international developments on education and instruction services. Accordingly, GCTP is divided into three competency domains which are professional knowledge, professional skills, and attitudes and values (MoNE, 2017). Competency domain of professional knowledge includes teachers' content knowledge, pedagogical content knowledge and knowledge of legislation. GCTP is related to not only practicing teachers but also pre-service teachers. The problems experienced by pre-service science teachers, who are the focus of the current study, are intensely discussed in the literature, which is briefly stated below.

It is discussed in the literature that pre-service science teachers cannot completely adopt student-centred methods (Yıldırım, Sürmeli, Benzer, & Şahin, 2007), their levels of scientific processing skills are low (Çakır & Sarıkaya, 2018; Önal, Büyük, & Saraçoğlu, 2017), therefore they have difficulty in transferring their subject matter knowledge to practice (Ercan, Coştu, & Coştu, 2018). Pre-service science teachers' cognitive awareness levels are not adequate (Emrahoğlu & Öztürk, 2010) and they have problems with scientific creativeness (Demirhan, Önder, & Beşoluk, 2018). They cannot reflect scientific facts to daily life as expected (Balkan-Kıyıcı & Aydoğdu, 2011; Yalçın, Altun-Yalçın, Akar, & Sağırlı, 2018), which negatively affects pre-service teachers' levels of self-confidence towards their profession (Şenol, Akyol, & Can-Yaşar, 2018). Pre-service teachers lack experience in experimenting (Pekbay & Kaptan, 2014), that's why they develop negative attitudes towards laboratory (Ünal & Kılıç, 2016). Pre-service teachers have a low level of reflective thinking skills (Elmalı & Kıyıcı, 2018; Töman & Çimer, 2014) and they are now knowledgeable in out of school learning environments (Tatar & Bağrıyanık, 2012). Some studies suggest that pre-service teachers do not get into education faculties consciously (Hacıömeroğlu & Taşkın, 2010), they do not know much about alternative assessment and evaluation techniques (Yeşilyurt, 2012), they do not fully comprehend constructivist learning settings (Evrekli, İnel, Balım, & Kesercioğlu, 2009; Yeşilyurt, 2013). Pre-service teachers' teaching practice experiences are insufficient and for that reason, teaching practice courses should be elaborated (Can, 2015). Although pre-service teachers have theoretical knowledge on active learning methods, they have problems in using these methods (Çelik & Bayrakçeken, 2014), therefore, they are resorting to traditional methods and techniques such as lecturing and question-answer in their practice courses in the education faculty (E. G. Yıldırım, Köklükaya, & Aydoğdu, 2016). They lack experience in learning methods based on questioning (Turan & Kocakülah, 2017). They do not fully possess the healthy living behaviors that are present personal development and professional competency domains (Yurdatapan, Benzer, & Güven, 2014). Pre-service science teachers cannot efficiently make use of analogies (Hıdır & Körhasan, 2018). Most of the pre-service teachers lack in critical thinking skills (Kutluca, Yılmaz, & İbiş, 2018), effective decision strategies in socio-scientific issues (Atasoy, 2018; Demiral & Türkmenoğlu, 2018) and on issues such as the nature of the science and technology (Dursun & Özmen, 2018). Besides, it is suggested that pre-service teachers should be more knowledgeable on STEM and 21st- century skills, which are the focus of attention in 2018 secondary school science curriculum (Kan & Murat, 2018).

Considering the research findings above, it can be asserted that studies mostly focus on 2013 science curriculum and there are few studies on 2018 SSSC. The studies mostly collected data on the efficiency of methods, opinions regarding the intended curriculum and included experimental studies in order to meet the deficiencies of pre-service teachers. There are rare studies focusing on intended curriculum and enacted curriculum. In brief, the studies in the literature do not comprehend the revisions in science curricula. However, it is now known to what degree the changes aimed in the science curricula are reflected to pre-service teachers.

This study aims to put forth how and to what degree pre-service science teachers can practice 2018 Secondary School Science Curriculum and offer theoretical recommendations about the issue of research. It is envisaged that describing clearly the deficits of pre-service teachers in enacting 2018 SSSC will contribute to the field and lead the way for further research in deciding what to focus on. The curriculum this current study focuses on is science curriculum which was piloted with fifth graders in 2017 by MoNE and has been in practice in all secondary schools as of 2018.

This study seeks to answer the research questions below:

1- To what degree do pre-service science teachers reflect their content knowledge aimed in the curriculum?
2- To what degree do pre-service science teachers reflect their pedagogical content knowledge aimed in the curriculum?
3- To what degree do pre-service science teachers reflect planning instruction activities aimed in the curriculum?

Method

Research Design

This study employs a qualitative case study design. Case study is a qualitative research method in which the researcher examines one or several cases with data collection tools in its boundaries and provide detailed descriptions on the case (Creswell, 2014). The cases examined in case studies can include curricula and policies (McMillan & Schumacher, 2001). Case study enables the researcher to describe and evaluate the case of concern in detail (Lincoln & Guba, 1985). Thereby, the evaluations can transform into a holistic perspective.

In this study, illustrative case study is preferred. Merriam (1998) argues that illustrative case study provides detailed information as to the case in education research. In this type of studies, the researcher has to collect a big amount of data in order to be able to interpret the case. Therefore, theoretical framework is given priority in this study. As there are not sufficient studies on science curriculum which has been in practice since 2018, illustrative case study is preferred in this study as opposed to evaluative case study.

Study Group

All researchers wish to select a sample that represents the population; however, regarding the science pre-service teachers as the participants of the study, the facts that there are science teaching programs at over 85 universities, thousands of students who have graduated or still study make it hard to select a sample that that represents the whole population. Therefore, this study adopted purposive sampling method which is a type of non-probability sampling methods. Through purposive sampling, data can be gathered quite quickly and in an economic and easy to access way. With data gathered through purposive sampling, it is aimed to describe the case in detail rather than trying to generalize them. In quantitative studies, the participants can be selected through purposive sampling method in a way to reach them easily and anytime in order to understand the phenomenon of the study (Creswell, 2014).

The participants consist of 28 senior pre-service science teachers studying at science teaching program at university and taking “Subject-specific teaching methods-II” course from the researcher. The participants’ distribution of gender, and frequency and percentage of grade levels of teaching practice subject are given in Table 1.

Table 1. The participants' demographics

	Male	**Female**	**Total**	**Percentage**
6th grade subjects	4	14	18	64.7
7th grade subjects	1	9	10	35.3
TOTAL	5	23	28	100

Data collection tools

In qualitative studies, data on demographics, social, cultural characteristics are collected in order to identify the cases in the study and how these cases affect the participants (Yıldırım & Şimşek, 2016). Data collection tools in qualitative studies include observation, interview, document analysis, audio and visual materials (Ekiz, 2003). Patton (2015) argues that an expanse description is needed in qualitative studies in order to minimize the deficiencies of data collection tools. In the current study, an elaborate theoretical framework is offered in the introduction to this end. In order to ensure validity and reliability in the current study, data sources are varied by using document analysis, observation forms and researcher journals (Merriam, 1998). Instruments of the study are explained respectively.

Document Analysis

Documents are sources of data that helps in understanding the case of the study (Creswell, 2014). Yin (2018) points out that document analysis can be used in order to draw some results through providing descriptions within the study and it can also be used a clue for future research. Government documents, official correspondence, minutes of meetings, written reports, newspaper pieces are some of the documents (Creswell, 2014; Yin, 2018). Which documents are going to be used within the research have to do with the causes in the case (Yıldırım & Şimşek, 2016).

In the current study MoNE 2018 SSSC (MoNE, 2018b), MoNE GCTP (MoNE, 2017) and related literature were examined through document analysis. Some of these data were written documents and some of them were retrieved from official websites. Elements of the intended curriculum were elaborately examined and categories were defined based on this analysis. As a result of the analysis, three categories in accordance with expectations of the curriculum from teachers and research questions are as follows: "Content Knowledge", "Pedagogical Content Knowledge" and "Planning instructional activities".

Semi-structured observation form

The data of the research were collected through a semi-structured observation form. The observation form had been developed as part of pre-service teachers' teaching practices by MoNE Directorate General for Teacher Training and Improvement. This form overall covers the activities of "content knowledge", "pedagogical content knowledge" and "planning instructional activities" which are related to teaching profession (MoNE, 2018c). Two specialist faculty members and two doctoral students examined the items in the semi-structured observation form. After discussions on the validity of the items in the observation form, consensus was built that the items ensured content validity. Besides, the observation form used in the study was evaluated in "Subject-specific teaching methods-I" course as a pilot study through video recordings of five students and two observers (a field specialist and the researcher). As a result of the assessment, the percentage of basic match between the analyses of the specialist and the researcher was calculated as 90%. In addition, after an exchange of opinions, the mismatches were eliminated. These results show that it is acceptable with respect to interrater reliability. Besides, the observation form used in the current study is a form used nationwide in assessing pre-service teachers' "teaching practice" courses in Turkey. The form is composed of two parts for general evaluation of pre-service teachers in Turkey, developed in line with the protocol between MoNE and Turkish Council of Higher Education. The first part is structured and composed of scores given depending on pre-service teachers' possession of related behavior. Accordingly, in the first part of the form, the rater assigns scores for fifteen related behaviors based on pre-service teachers' performance.

If the related behavior cannot be observed or is observed but in a limited way in pre-service teachers by the rater, the score is (1) point, meaning *inadequate.*

If the related behavior can be observed in a sufficient way in pre-service teachers by the rater, the score is (2) point, meaning *acceptable.*

If the related behavior can be observed in an excellent way in pre-service teachers by the rater, the score is (3) point, meaning *well trained.* In the observation form, inadequate was coded as (E), acceptable was coded as (K) and well trained was coded as (I) by the researcher. Frequencies and percentages of observation of related behaviours were calculated.

The second part of the observation form is composed of six parts enabling noting, in detail, the performance of pre-service teachers while enacting the related behaviors. This part includes sub-parts of "content knowledge and pedagogical content knowledge", "ability to get to know students and approach to students", "creating appropriate learning environment", "assessment of student achievement" "lesson planning and practice" and "professional attitude and approach to values". The observed behaviors were scored by the researcher on the observation form based on pre-service teachers' performances (Inadequate: 1, Acceptable: 2, Well trained: 3). The semi-structured observation form is provided in Appendix-1.

Researcher's Journals

In the research study, the researcher also took notes through a researcher's journal in the observation process beside the evaluation of students through observation form. The main reason for keeping a journal was to enable in-depth analysis of data. The notes in the researcher's journals were aimed to help in explaining the pre-service teachers' practice level of the intended curriculum. The notes were categorized in the dimensions of content knowledge, pedagogical content knowledge and planning of instructional activities.

Data Collection

This study was carried out with senior pre-service science teachers at an education faculty in the spring semester of 2018. The focus of the study is SSSC that had been piloted with fifth graders in 2017 and started to be implemented at all levels of secondary schools in Turkey in 2018. The study was implemented within the "Subject-specific teaching methods-II" course which is a course of science teaching program at education faculties offered to pre-service teachers at the fourth year. The courses were instructed by the researcher himself. The duration of the course was 4 hours a week (2 hours of theory, 2 hours of practice). The course content is defined by council of higher education and requires pre-service teachers to select a subject from the current secondary school science curriculum, prepare a lesson plan, arrange the environment, tools and materials and present the lesson as well as assessment of the presentation with respect to teaching knowledge and skills (CoHE, 1998).

In the first half of the fourteen-week semester program, the theoretical content of the course was instructed to the pre-service teachers by the researcher. The content of the theoretical framework lectured elaborately by the researcher includes the 2018 SSSC in practice developed by MoNE, learning outcomes of the curriculum, issues to consider in the implementation of the curriculum, methods, techniques and materials that are to be used in the lessons, and issues to consider in lesson planning. In addition, the pre-service teachers were informed about according to what criteria they would be assessed by giving them the observation form used in the study and they were directed about what would be taken into consideration in the assessment of their presentations. Through informing students about their assessment, the validity and reliability of the observation form were aimed to be increased.

In the second half of the course, the pre-service teachers had the chance to practice teaching. To this end, the subjects, in line with the science curriculum, were randomly assigned to pre-service teachers. Accordingly, the pre-service teachers had 40 minutes to perform their practices and the observation forms were filled in meanwhile. All of the 28 participants were observed and assessed. During the observation, the researcher never interrupted the pre-service teachers and his role was nonparticipant observer.

Data Analysis

Analysis of observation data

In qualitative research, the findings of the data after the analysis are transferred to tables, figures or graphs. They can also be presented with a discussion. Since the aim of qualitative research is to explain the existing case rather than making generalizations, there is not a standard procedure of data analysis. The analysis of the data depends on the researcher, the aim of the research, and the data obtained (Creswell & Poth, 2018; McMillan & Schumacher, 2001). In the analysis of data in the current study, descriptive analysis was employed. The aim of descriptive analysis is to identify the common trends in the phenomenon of question (Miles, Huberman, & Saldana, 2014).

The observations were assessed with criteria based on 2018 SSSC and GCTP prepared by MoNE in 2017. In the document analysis, the preservice teachers were assessed based on their level of meeting the expectations that are explained below.

Content Knowledge

GCTP prepared by MoNE was examined to identify the criteria (MoNE, 2017). The criteria drawn from this document include the ability to use various strategies, methods and techniques that are related to teaching area, knowledge of scientific terminology of teaching area, knowledge of assessment and evaluation processes that can be used in the instruction, explaining all aspects of the related curriculum in detail, and knowledge of students' development and learning characteristics.

Pedagogical content knowledge

These criteria were based on strategies and methods adopted in science curriculum (MoNE, 2018b). These include the use of "problem, projects, argumentation, collaborative learning, research-questioning based learning strategy' in the lessons. Besides, GCTP requires teachers to use various strategies, methods and techniques.

Planning instructional practices

Skills specific to science curriculum were focused on in this dimension. The activities in the curriculum scientific process skills to enable students to observe, assess, categorize, store data, and set models. According to the curriculum, the learning environments should aim the development of team work, decision making, analytical thinking, creative thinking and communication skills. It was also decided based on learning environment approach in the science curriculum that the students should actively participate in learning processes. In 2018 SSSC, evaluation approach expected from the teacher is summative and formation evaluation approach.

Below is a sample of the evaluation of pre-service teachers through the observation form.

> ***Sample cases of observation of pre-service teachers' teaching presentations:***
>
> **Subject: Urinary system (sixth grade)**
>
> **Learning outcome:** "The student summarizes the tasks of urinary system by showing the structures and organs forming it on a model."
>
> **The recommendation of 2018 SSSC with respect to the learning outcome:** "*The tasks and importance of kidneys in urinary system are highlighted but detailed structure of kidneys (nephron, cortex, calyx, core and so on) is not focused on."*
>
> The pre-service teacher clearly explained the importance of the subject, its relationship with the previous lesson and the contents of the current lesson in the warm-up section of the lesson. Pre-service teacher's this behavior was noted in the "planning and performing the lesson" section in the second part of the observation form and it was scored as 3 points by selecting "well trained" option in "relating the subject with the previous and following lessons" section in the first part of the form.

Then the pre-service teacher stated: "Friends, what do you know about urinary system? Let's brainstorm on this issue." Students started to state what they know about the issue respectively.

Later, the pre-service teacher said: "Our kidneys clean the blood. The blood that is filtered through kidney gets cleaned. As seen in the power-point slide, renal veins carry clean blood". This was noted by the researcher in "content knowledge and mastery of subject area" section of the second part of the observation form. In the same way, this was scored 1 point by selecting "inadequate" option in "knowledge of basic concepts in the subject area" section in the first part of the form. Because, students had the possibility to get confused whether the concept of "clean" refers to the kidney or the amount of oxygen in the blood as renal veins carry venous blood indeed". Therefore, it was scored as inadequate.

During the lesson, a student asked: "My Teacher, how is kidney stone occur in our bodies?". The pre-service teacher replied: "Now, we are not dealing with that subject. We will learn it in the following weeks. It is not an appropriate time for that question now.". This reaction was noted in "ability to get to know students and approach to students" section of the second part of the observation form. In the same way, this was scored 1 point by selecting "inadequate" option in "Giving appropriate and adequate answers to students' questions" section in the first part of the form.

The pre-service teacher brought a real sheep kidney to the class. While examining this kidney, he also reflected the synchronous video recording with a projector so that everyone could see it. In this way, each student had the chance to see the structure of the kidney easily. This was noted in "Creating appropriate learning environments" and "planning and performing the lesson" sections in the second part of the observation form. This was also scored 3 points by selecting "well trained" option in "selecting and preparing appropriate tools and materials" and "making use of instructional technologies" sections in the first part of the form. In addition, the pre-service teacher put away the bisturi he used in the examination of the kidney. This behavior was scored 3 points by selecting "well trained" option in "securing the learning environment" section in the first part of the form.

During the lesson, the pre-service was active while the students were passive. He preferred traditional methods such as "lecturing" and "question-answer" and therefore the students were observed as bored. This was scored 1 point by selecting "inadequate" option in "identifying methods and techniques in accordance with learning outcomes" section in the first part of the form

In the later part of the lesson, the pre-service teacher distributed a test paper including only multiple-choice questions to students. As 2018 SSSC adopts summative assessment as expected competencies from teachers, this behavior was noted in "assessment of student achievement" in the second part of the observation form and scored 1 point by selecting "inadequate" option in "identifying appropriate assessment methods for learning outcomes" section in the first part of the form.

Analysis of the researcher's journal

In the content analysis of the researcher's journal, categories were created based on the expectations from teachers present in 2018 SSSC. Negotiations were held with two specialists in the formation of codes and categories were determined after these. The categories include content knowledge, pedagogical content knowledge and planning instructional activities. The categories and related behaviors are explained below respectively.

Category of content knowledge: In this category, it was tried to understand whether the pre-service teachers had mastery in the scientific terminology of one's presentation topic and subject area. The researcher focused on pre-service teachers' theoretical knowledge in the subject area and regarding notes were taken.

Pedagogical content knowledge: The researcher focused on which methods and strategies the pre-service teachers resorted to in their practice and whether they used them properly

Planning instructional activities: This category has to do with which methods the pre-service teachers use in assessment and evaluation, whether they use alternative assessment methods, and whether they use them properly besides pre-service teachers' efficiency level of material use and the appropriateness of the materials for the students' levels.

Findings

Within the research, each of the 28 participants was observed for one course hour and 28 observations were carried out in total. The findings in the researcher's journal that are not present in the observation form are also provided here. The findings obtained from observation forms and researcher's journals are given with their frequencies and percentages in content knowledge, pedagogical content knowledge and planning instructional activities categories respectively.

In the analysis of pre-service teachers' observation forms in "content knowledge" category, it was determined that the teachers had to master the curriculum and the contents of the curriculum according to GCTP developed by MoNE. This framework also requires teachers to have advanced level theoretical, methodological and phenomenological knowledge comprising a questioning perspective in the subject area. Therefore, MoNE demands teachers to have an interdisciplinary perspective as well as knowing subjects and concepts within one's expertise (MoNE, 2017, 2018b).

Based on the analysis of observation forms, frequencies and percentages of pre-service teachers' behaviors observed in the category of content knowledge are provided in Table 2.

Table 2. Frequencies and percentages of behaviors observed in the category of content knowledge

		Knowledge of basic principles and concepts in the subject area			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	2	15	11	28
	Percentage	7	54	39	100

		Relating basic principles and concepts with a logical coherence			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	3	14	11	28
	Percentage	11	50	39	100

		Using verbal and visual language relevant to the subject appropriately			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	7	15	16	28
	Percentage	25	54	21	100

		Relating the subject with other subjects in the content area			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	-	17	11	28
	Percentage	-	61	39	100

Table 2 suggests that the participating pre-service teachers have a level of acceptable and well trained with respect to "knowledge of basic principles and concepts in the subject area" (54%+39%). In the category of content knowledge, the biggest deficiency in pre-service teachers is the area of "using verbal and visual language relevant to the subject appropriately" with 25%. "Relating the subject with other subjects in the content area" is the area where the pre-service teachers have the best performance. Their percentage is 61% for acceptable and %39 for well trained.

With respect to pedagogical content knowledge, based on 2018 SSSC, it can be argued that MoNE expects teachers to master pedagogical content knowledge as well as content knowledge. Similarly, GCTP developed by

MoNE requires teachers to know and practice various methods, techniques and strategies in the area of expertise, create secured learning environments, and explain all elements of the related curriculum in detail (MoNE, 2017). In 2018 SSSC, it is expected from teachers to raise students who do research, discuss and explain based on research-questioning driven learning method (MoNE, 2018b). Based on the analysis of observation forms, frequencies and percentages of pre-service teachers' behaviors observed in the category of pedagogical content knowledge are provided in Table 3.

Table 3. Frequencies and percentages of behaviors observed in the category of pedagogical content knowledge

		Knowledge of instructional approaches, methods and techniques			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	8	16	4	28
	Percentage	29	57	14	100
		Making use of instructional technologies			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	10	12	6	28
	Percentage	36	43	21	100
		Identifying students' misconceptions			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	8	15	5	28
	Percentage	29	54	17	100
		Giving appropriate and adequate answers to students' questions			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	11	12	5	28
	Percentage	39	43	18	100
		Securing the learning environment			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	-	9	19	28
	Percentage	-	32	68	100

It is seen in Table 3 that, the pre-service teachers' biggest deficiencies lay in "giving appropriate and adequate answers to students' questions" area. Similarly, "making use of instructional technologies" follows it with 36%. With respect to securing the learning environment, the pre-service teachers have a level of acceptable and well trained. Regarding knowledge of instructional approaches, methods and techniques, most of the participants have a level of acceptable and well trained.

In the category of planning instructional activities, GCTP requires teachers to prepare materials that are appropriate for the learning outcomes and arrange activities that develop students' higher order cognitive skills. Furthermore, summative and formative assessment, preparing tools and materials appropriate for learning environments, using problem, project, argumentation, cooperative learning methods to have students reach the learning outcomes are also expected (MoNE, 2017, 2018b). Based on the analysis of observation forms, frequencies and percentages of pre-service teachers' behaviors observed in the category of planning instructional activities are provided in Table 4.

Table 4. *Frequencies and percentages of behaviors observed in the category of planning instructional activities*

		Writing a clear, comprehensible and well-ordered lesson plan			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	10	12	6	28
	Percentage	36	43	21	100
		Stating the goals and target behaviors clearly			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	13	11	4	28
	Percentage	47	39	14	100
		Identifying appropriate methods and techniques for target behaviors			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	8	15	5	28
	Percentage	29	54	17	100
		Selecting and preparing appropriate tools and materials			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	14	10	4	28
	Percentage	50	36	14	100
		Identifying appropriate assessment methods for target behaviors			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	12	12	4	28
	Percentage	43	43	14	100
		Relating the subject with previous and following lessons			Total
		Inadequate	Acceptable	Well trained	
Total	Frequency	1	19	8	28
	Percentage	3	68	29	100

Table 4 displays that the biggest deficiencies of the pre-service teachers lay in the category of "planning instructional activities". It is identified that half of the participating pre-service teachers have deficiencies in "selecting and preparing appropriate tools and materials". They have a deficiency of 43% with respect to "identifying appropriate assessment methods for target behaviors". The pre-service teachers have the best performance in "Relating the subject with previous and following lessons". Only 3% of the participants are observed to be inadequate in this respect.

Findings obtained from the researcher's journal

Findings obtained from the category of "content knowledge" in the researcher's journal are explained as follows. Most of the pre-service teachers were observed to be very excited during their presentations. In addition, some pre-service teachers had learning outcomes that were either beyond or below the learning outcomes defined by MoNE. For instance, a pre-service teacher lecturing about neural system said: "Yes friends, we will talk about neural system cells. Neural system cells are called neuron. Neurons are composed of axon and dendrite". The concept of "axon" and "dendrite" are demanded to be excluded in 2018 MoNE SSSC. Another pre-service teacher was talking about "constant speed motions" and he taught the subject using

formulas; however, 2018 SSSC demands not to teach students mathematical formulas in this subject. It is also observed that pre-service teachers did not conform to durations of learning outcomes recommended in 2018 SSSC and taught the subjects in very short durations. This fast lecturing of pre-service teachers caused the students' lack of understanding the subject.
Findings obtained from the category of "pedagogical content knowledge" in the researcher's journal are explained in this paragraph. Most of the pre-service teachers preferred "question-answer" method. Yet, in this method, the pre-service teachers answered the questions themselves without giving the students the chance to revise themselves. Most of the pre-service teachers did not display appropriate behaviors regarding reinforcement. They either provided reinforces for every answer or they did not provide reinforcers for most of the answers. In this context, it was observed that the pre-service teachers did not know when and how to use reinforcers. Another finding the journal is that the pre-service teachers generally taught lesson uni-directional and monotonously. Regarding instructional technologies, the pre-service teachers generally lectured superficially the issues involving technology. For instance, a pre-service teacher, teaching the subject of "the solar system and planets", used only a visual on power-point slide which was also not clear. The pre-service teacher did not use any animations or holograms. A student told this pre-service teacher: "Teacher, we have a 3D television at home. I watched a 3D movie about space recently. I felt like I was in the space". However, the classroom the pre-service teacher was practicing has the equipment to realize this activity easily. Some other pre-service teachers allocated very little time for the theory of the subject and taught the lesson based on practice. Some other pre-service teachers were observed to practiced methods and techniques improperly.

It was identified in the "planning instructional activities" category of the researcher's journal that the pre-service teachers used 5E method in most of their daily lesson plans; however, the pre-service teachers mostly performed a teacher-centered teaching practice. Besides, the evaluation questions about the subject prepared by the pre-service teachers for students were in the category of traditional evaluation approach. Most of the pre-service teachers used multiple-choice questions. The materials were also inadequate with respect to visuality. For instance, it was observed that the students sitting at the back of the classroom could not see the materials. The materials also included foreign words as well as knowledge that is far beyond the learning outcomes. While showing videos about the subject of the lesson, some pre-service teachers waited till the end of the video and did not make any explanations during the video.

Discussion and Conclusion

In this part, the findings obtained from the observation form and researcher's journal are discussed in line with the findings in the literature. Pre-service teachers'' levels of practicing 2018 SSSC are discussed within the categories of content knowledge, pedagogical content knowledge and planning instructional activities respectively.

Results regarding pre-service teachers' practice in the category of content knowledge

According to the results obtained from the observation form, Table 2 reveals that the participating pre-service teachers had mastery in basic principles and concepts of subject area and they could successfully relate the content with other contents of subject area. It is considered that this result stems from the fact that the pre-service teachers study for subject area examination of Public Personnel Selection Examination to become teachers (Erdem & Soylu, 2013). In the category of content knowledge, it is observed that the biggest deficiency in pre-service teachers is the area of using verbal and visual language relevant to the subject appropriately. This case involves visual knowledge (figure, scheme, graphic, formula) about the subject area. These are considered as scientific process skills in science curriculum. The troubles pre-service teacher experience with scientific process skills are discussed in the literature (Çakır & Sarıkaya, 2018; Demirhan et al., 2018; Emrahoğlu & Öztürk, 2010; Önal et al., 2017). It is highlighted that the reason for the deficiencies in preservice teachers' scientific process skills stems from the fact that they do not practice activities involving project and problem-solving method in their undergraduate courses. A general overview of Table 2 would suggest that pre-service teachers' mastery in content knowledge is at a level of acceptable and high.

The notes in the researcher's journal reveal that the pre-service teachers were really excited in their practices. It was observed that though most of the pre-service teachers knew the content, they used improper statements in their teaching. It is thought that this case originates from inadequate number of applied courses in the education faculty. The literature also suggests that more applied courses are needed in education faculties (Çelik & Bayrakçeken, 2014; Hacıömeroğlu & Taşkın, 2010; Saka, 2019). The preservice teachers mostly included

mathematical formulas while teaching their subjects. This case may be rooted in the fact that the pre-service teachers are used to multiple-choice testing in their evaluation experiences so far. The pre-service teachers also included concepts that were beyond the learning outcomes and students' level or readiness, which may be due to the fact that they did not examine the science curriculum in detail. In addition, it was observed that the pre-service teachers did not abide by the durations that had been allocated for learning outcomes in 2018 SSSC and they taught the subjects in relatively very short time.

Results regarding pre-service teachers' practice in the category of pedagogical content knowledge

According to the results obtained from the observation form, Table 3 unearths that the biggest deficiency in pre-service teachers is the area of knowledge of instructional methods and techniques. This finding is in line with the literature (Yıldırım et al., 2016). It was observed that the pre-service teachers mostly preferred traditional direct instruction method. The results suggest that pre-service teachers teach through behaviorist methods such as lecturing or question-answer. Previous studies also had similar results (Atila, 2012). It is thought that the tendency to these methods is a result of their fear of inability to complete teaching the subjects (Hằng et al., 2017; Tekbıyık & Akdeniz, 2008). In some other studies, it was found out that pre-service teachers did not have adequate knowledge regarding alternative methods and techniques (Elmalı & Kıyıcı, 2018; Yıldırım et al., 2007). It is a significant result that although it was found out in a number of studies that pre-service teachers had positive attitudes towards curriculum revisions, they prefer traditional teaching methods in practice (Toraman & Alcı, 2013). The findings reveal that the pre-service teacher did not give much place to projects in teaching practices. This finding is also in line with the literature (Baysura, Altun, & Yücel-Toy, 2016; Bulunuz, Tapan-Broutin, & Bulunuz, 2016).

It was observed that the pre-service teachers improperly practiced the methods they had included in their lesson plans. This deficiency also affected the area of giving appropriate answers to students' questions (Table 3). Another deficiency in the pre-service teachers was in the area of making use of instructional technology (Table 3). This finding is in line with another study (Arias et al., 2016). In the new curricula of teacher education by Council of Higher Education, the content of "Instructional technologies and materials" course were revised to be more efficient and changed into "instructional technologies" course (CoHe, 2018b). It was also observed that the pre-service teachers had deficiencies in identifying students' misconceptions. The problems of identifying and solving students' misconceptions are well discussed in the literature (Selvi & Yakışan, 2004). MoNE pays attention to "concept teaching" in 2018 SSSC. In Table 3, it is seen that pre-service teachers' behaviors regarding securing learning environment are at a level of acceptable and high. It is taught that this may have to do with the fact that they did not make use of any dangerous experiments. Besides, it is stated in the literature that activities requiring applications could not be performed in classrooms where needed platforms and physical environments are not proper (Günes & Baki, 2011).

The results in the researcher's journal reveal that some pre-service teachers did not allocate much time to theoretical knowledge and moved on to activities before students understood the content. Because the students could not understand the basics of the subject, the students could not understand the activities and did not participate in them. It was also observed that the pre-service teachers used the reinforcers improperly in pedagogical content teaching (Babayiğit & Erkuş, 2017).

Results regarding pre-service teachers' practice in the category of planning instructional activities

Based on the results obtained from the observation form, Table 4 unearths that the pre-service teachers had deficiencies in areas of selecting and preparing appropriate tools and materials. These results are in line with the results in the area of making use of instructional technologies (Table 3). According to the findings in Table 4, their biggest deficiency is in the area of planning the lesson. However, planning instructional activities enable teachers to reach the learning outcome at the best time, and teaching the content efficiently with ease. Although it was highlighted in the theoretical part of the course that planning is very important, the pre-service teachers' deficiencies in this respect are salient. It is remarkable that the percentage of well-trained pre-service teachers is only 21.4%. Table 4 suggests that they also have deficiencies in identifying appropriate methods and techniques for target behaviors. It is seen in Turkey that there are various problems regarding the practice and efficiency of assessment and evaluation methods reflecting the constructivist approach (Gelbal & Kelecioğlu, 2007). Although the teachers had positive attitudes towards summative assessment and evaluations in another study (Çıray, Küçükyılmaz, & Güven, 2015), most of the pre-service teachers in the current study preferred formative assessment.

The results of the study reveal that there is a mismatch between the contents targeted by MoNE in 2018 SSSC and the content perceived by pre-service teachers. It is found out that pre-service teachers' content knowledge is superior to their pedagogical content knowledge. However, it is very important for a teacher to know how to teach a subject as well as having content mastery in that subject area. The problems experienced by teachers and pre-service teachers are with respect to teaching pedagogical content are highlighted in the literature. Pedagogical content knowledge is featured in 2018 SSSC. Besides, CoHE has allocated about half of the courses to pedagogical content teaching in the revisions (CoHE, 2018a). In this context, it can be argued that this decision is a right and appropriate one.

The researcher's journal puts forth that the pre-service teachers generally adopted 5E model in their lesson plans. However, in their practices, they had a teacher-centred teaching style even in activities with student participation, which is not in accordance with 5E method. Therefore, the lesson plan and the pre-service teachers' actual practices were not in accordance. Furthermore, the pre-service teachers mostly used either multiple-choice tests or true-false type exercises in the assessment of students. The pre-service teachers adopted formative evaluation methods as opposed to summative evaluation, which is not in line with 2018 SSSC. Some of the materials prepared by the pre-service teachers included foreign words or they included contents that were beyond the learning outcomes. This is not appropriate regarding the principles of "appropriates to students' level of readiness" and "clarity". Similarly, it was observed that some pre-service teachers started a video on the subject and had the students watch it till the end. They did not explain important parts in the videos and it was observed that the students could not understand the subject well.

Recommendations

Based on the issues stated in 2023 Education Vision announced by MoNE, it is expected that there will be revisions in the curricula in a short while (MoNE, 2018a). In accordance with this, pre-service teachers should be definitely included to the significance attached to theoretical framework and revisions because it is necessary for pre-service teachers to be equipped with teaching skills, have mastery in the content knowledge and curriculum of their area of expertise as they will be the ones to implement the curricula in the future. No education model can provide a service beyond the quality of its personnel who operate it (Kavcar, 1987). A school can only be as good as its teachers.

Within this notion, it is recommended that pre-service teachers should perform teaching practices in MoNE schools not only as a part of only 'teaching practice' course but also as parts of other courses as well. For instance, Subject-specific teaching methods-II" course could be practiced in MoNE school with planning and could be more efficient. In addition, it is also suggested that the predominance endowed to subject area examination of Public Personnel Selection Examination should be balanced with educational sciences. In line with this, Student Selection and Placement Center should lessen the ratio of subject area examination and increase the ratio of educational sciences examination and thereby reach to a balance.

References

Arias, A. M., Bismack, A. S., Davis, E. A., & Palincsar, A. S. (2016). Interacting with a suite of educative features: elementary science teachers' use of educative curriculum materials. *Journal of Research in Science Teaching, 53*(3), 422-449. doi:10.1002/tea.21250

Atasoy, Ş. (2018). Student teachers' informal reasoning of local socioscientific issues according to the living places. *Fen Bilimleri Öğretimi Dergisi, 6*(1), 60-72.

Atila, E. (2012). *Science and technology teachers? perceptions and implementation of constructivist principles in science and technology curriculum.* (Unpublished Doctoral Thesis), Atatürk University, Insitute of Education Sciences, Erzurum, TURKEY. (319674).

Ayas, A., & Çepni, S. (2016). Eğitimde program geliştirme ve bazı fen ve teknoloji programları. In S. Çepni (Ed.), *Kuramdan Uygulamaya Fen ve Teknoloji Öğretimi* (Vol. 13, pp. 16-51.). Ankara, Turkey: Pegem Akademi Yayıncılık.

Babayiğit, Ö., & Erkuş, B. (2017). Effectiveness of reinforcements and punishments which primary school teachers use in lessons. *Kastamonu Education Journal, 25*(2), 567-580.

Bahar, M., Yener, D., Yilmaz, M., Emen, H., & Gürer, F. (2018). The changes of standards in the 2018 science curriculum and STEM integration. *Bolu Abant Izzet Baysal University, Journal of Faculty of Education, 18*(2), 702-735.

Balkan-Kıyıcı, F., & Aydoğdu, M. (2011). Determination of pre-service science teachers' levels of relating the scientific knowledge to their daily lives. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 5*(1), 43-61.

Baskan, G. A., Aydın, A., & Madden, T. (2006). Türkiye'deki öğretmen yetiştirme sistemine karşılaştırmalı bir bakış. *Journal of Çukurova University Institute of Social Sciences, 15*(1), 35-42.

Bayrak, N., & Doğan, S. (2018). Examination in terms of formative measurement and evaluation of biology teacher feedbacks. *Bolu Abant Izzet Baysal University, Journal of Faculty of Education, 18*(2), 752-774.

Baysura, Ö. D., Altun, S., & Yücel-Toy, B. (2016). Perceptions of teacher candidates regarding project-based learning. *Eurasian Journal of Educational Research, 62*(3), 15-36. doi:10.14689/ejer.2016.62.3

Bulunuz, M., Tapan-Broutin, M. S., & Bulunuz, N. (2016). Pre-Service teacher scientific behavior: comparative study of paired science project assignments. *Eurasian Journal of Educational Research, 62*(195-218.). doi:10.14689/ejer.2016.62.12

Büyüktokatli, N., & Bayraktar, Ş. (2014). Alternative assessment practices in science. *Pegem Journal of Education & Instruction, 4*(1), 103-126. doi:10.14527/pegegog.2014.006

Can, H. (2015). Sources of teaching efficacy beliefs in pre-service science teachers. *Elementary Education Online, 14*(1), 333-348. doi:10.17051/io.2015.84390

CoHE. (1998). Fen bilgisi öğretmenliği lisans programı. Retrieved from http://www.yok.gov.tr/documents/10279/49665/fen_bilgisi/f385bc78-22df-497d-bfca-7aee80c75c22

CoHE. (2018a). Department of elementary science education curriculum. Retrieved from http://www.yok.gov.tr/documents/10279/41805112/Fen_Bilgisi_Ogretmenligi_Lisans_Programi.pdf

CoHE. (2018b). Öğretmen yetiştirme lisans programları. Retrieved from http://www.yok.gov.tr/documents/10279/41805112/AA_Sunus_+Onsoz_Uygulama_Yonergesi.pdf

Creswell, J. W. (2014). *Research design qualitative, quantitative and mixed methods approaches* (Vol. 4). USA: Sage Publications.

Creswell, J. W., & Poth, C. N. (2018). *Qualitative inquiry and research design: choosing among five approaches* (Vol. 4). USA: Sage Publications.

Çakır, N. K., & Sarıkaya, M. (2018). Evaluation of science process skills of pre-service science teachers. *Turkish Studies, 13*(4), 859-884. doi:10.7827/TurkishStudies.12823

Çelik, S., & Bayrakçeken, S. (2014). Pre-Service science teachers' attitudes toward project based learning approach. *Sakarya University Journal of Education Faculty (SUJEF), 27*, 7-24.

Çıray, F., Küçükyılmaz, E. A., & Güven, M. (2015). The views of teachers about the curriculum of science revised for secondary schools. *Dicle University Journal of Ziya Gökalp Faculty of Education, 25*, 31-56. doi:10.14582/DUZGEF.566

Delen, İ., & Uzun, S. (2018). Evaluating STEM based learning environments created by mathematics pre-service teachers. *Hacettepe University Journal of Education, 33*(3), 617-630. doi:10.16986/HUJE.2018037019

Demiral, Ü., & Türkmenoğlu, H. (2018). The relationship of preservice science teachers' decision making strategies and content knowledge in socio-scientific issues. *Journal of Uludag University Faculty of Education, 31*(1), 309-340.

Demirhan, E., Önder, İ., & Beşoluk, Ş. (2018). The change in scientific creativity and academic achievement of prospective science teachers by years. *Kastamonu Education Journal, 26*(3), 685-696. doi:10.24106/kefdergi.373323

Deniz, S., & Tican, C. (2017). An investigation of pre-service teachers' teacher self-efficacy beliefs and opinions for their professional anxieties. *Bolu Abant Izzet Baysal University, Journal of Faculty of Education, 17*(4), 1838-1859.

Dursun, B., & Özmen, N. (2018). Science preservice teachers' views on nature of science and technology. *Journal of Educational Sciences Research (JESR), 8*(1), 55-71. doi:10.22521/jesr.2018.81.2

Ekiz, D. (2003). *Eğitimde araştırma yöntem ve metodlarına giriş (nitel, nicel ve eleştirel kuram metodolojileri)*. Ankara, TURKEY: Anı Yayıncılık.

Elmalı, Ş., & Kıyıcı, F. B. (2018). Prospective science teachers' tendecies of reflective thinking and views about reflective thinking. *Elementary Education Online, 17*(3), 1706-1718. doi:10.17051/ilkonline.2018.466423

Emrahoğlu, N., & Öztürk, A. (2010). The effect of metacognition on the prospective science teachers' academic achievement: an ex post facto research. *Journal of Çukurova University Institute of Social Sciences, 19*(2), 18-30.

Ercan, O., Coştu, F., & Coştu, B. (2018). Identifying pre-service science teachers' difficulties about graph drawings. *Kastamonu Education Journal, 26*(6), 1929-1938. doi:10.24106/kefdergi.2227

Erdem, E., & Soylu, Y. (2013). Prospective teachers' opinions about CSSE and field examination. *Journal of Institute of Social Sciences, 4*(1), 223-236.

Eskicumalı, A., Demirtaş, Z., Erdoğan, D. G., & Arslan, S. (2014). The comparison df the science and technology curriculum and renewed science curriculum. *International Journal of Human Sciences, 11*(1), 1077-1094. doi:10.14687/ijhs.v11i1.2664

Evrekli, E., İnel, D., Balım, A. G., & Kesercioğlu, T. (2009). Fen öğretmen adaylarının yapılandırmacı yaklaşıma yönelik tutumlarının incelenmesi. *Journal of Uludag University Faculty of Education, 22*(2), 673-687.

Filiz, S. B., & Aydın, E. (2018). The problems of classroom teachers: a study based on the experiences of classroom teachers. *Cukurova University Faculty of Education Journal, 47*(2), 538-565. doi:10.14812/cuefd.375676

Gelbal, S., & Kelecioğlu, H. (2007). Teachers' proficiency perceptions of about the measurement and evaluation techniques and the problems they confront. *Hacettepe University Journal of Education, 33*, 135-145.

Günes, G., & Baki, A. (2011). Reflections from application of the fourth grade mathematics course curriculum. *Hacettepe University Journal of Education, 41*, 192-205.

Hacıömeroğlu, G., & Taşkın, Ç. Ş. (2010). Preservice teachers' attitudes towards teaching profession in primary and secondary education. *Kırşehir Eğitim Fakültesi Dergisi (KEFAD), 11*(1), 77-90.

Hằng, N. V. T., Bulte, A. M. W., & Pilot, A. (2017). Interaction of Vietnamese teachers with a social constructivism-based primary science curriculum in a framework appropriate for a confucian heritage culture. *Asia-Pacific Science Education, 3*(2), 1-33. doi:10.1186/s41029-017-0013-0

Hastürk, H. G. (2017). Fen bilimleri dersi öğretim programı. In H. G. Hastürk (Ed.), *Teoriden Pratiğe Fen Bilimleri Öğretimi* (Vol. 1, pp. 2-30.). Ankara, TURKEY: Pegem Akademi Yayıncılık.

Hıdır, M., & Körhasan, N. D. (2018). Examination of the analogies in science textbooks and opinions of science educators about the effective use of analogies. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 12*(2), 415-453.

Kan, A. Ü., & Murat, A. (2018). Investigation of prospective science teachers' 21st century skill competence perceptions and attitudes toward STEM. *International Online Journal of Educational Sciences, 10*(4), 251-272. doi:10.15345/iojes.2018.04.014

Karaman, P., & Karaman, A. (2016). Opinions of science teachers about the revised science education program. *Erzincan University Journal of Education Faculty, 18*(1), 243-269. doi:10.17556/jef.65883

Kavcar, C. (1987). Türk dili ve edebiyatı öğretimi. *Ankara University Journal of Faculty of Educational Sciences, 20*(1), 261-273. doi:10.1501/Egifak_0000001077

Kutluca, A. Y., Yılmaz, A., & İbiş, E. (2018). Examination of teacher candidates' critical thinking attitudes in terms of various variables. *Kastamonu Education Journal, 26*(4), 2045-2055. doi:10.24106/kefdergi.2309

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. USA: Sage Publications.

McMillan, J. H., & Schumacher, S. (2001). *Research in education* (Vol. 5). USA: Addison Wesley Longman, Inc.

Merriam, S. B. (1998). *Qualitative research and case study applications in education: revised and expanded from case study research in education*. San Francisco, CA: Jossey-Bass Publishers.

Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative data analysis a methods sourcebook* (Vol. 3). USA: Sage Publications.

MoNE. (2017). General competencies for teaching profession. Retrieved from http://oygm.meb.gov.tr/meb_iys_dosyalar/2018_06/29111119_TeachersGeneralCompetencies.pdf

MoNE. (2018a). 2023 eğitim vizyonu. Retrieved from http://2023vizyonu.meb.gov.tr/doc/2023_EGITIM_VIZYONU.pdf

MoNE. (2018b). Fen bilimleri dersi öğretim programı (ilkokul ve ortaokul 3, 4, 5, 6, 7 ve 8. sınıflar). Retrieved from http://mufredat.meb.gov.tr/ProgramDetay.aspx?PID=325

MoNE. (2018c). Uygulama öğrencilerinin Milli Eğitim Bakanlığına bağlı eğitim öğretim kurumlarında yapacakları öğretmenlik uygulamasına ilişkin yönerge. Retrieved from https://oygm.meb.gov.tr/meb_iys_dosyalar/2018_06/25172143_YYnerge.pdf

Newton, D. P. (1988). Relevance and science education. *Educational Philosophy and Theory, 20*(2), 7-12. doi:10.1111/j.1469-5812.1988.tb00139.x

Önal, N. T., Büyük, U., & Saraçoğlu, S. (2017). Scientific process skill levels of pre-service science teachers. *Marmara University Atatürk Education Faculty Journal of Educational Sciences, 47*(47), 69-84. doi:10.15285/maruaebd.292043

Patton, M. Q. (2015). *Qualitative research & evaluation methods* (Vol. 4). USA: Sage Publications.

Pekbay, C., & Kaptan, F. (2014). Improvement of pre-service science teachers' awareness on the effectiveness of laboratory method in science education: a qualitative study. *Karaelmas Journal of Educational Sciences, 2*(1), 1-11.

PISA. (2015). PISA Turkey performance. Retrieved from http://www.compareyourcountry.org/pisa/country/TUR?lg=en

Sağlam-Arslan, A., Devecioğlu-Kaymakçı, Y., & Arslan, S. (2009). Problems concerning alternative evaluation methods: the case of science and tehnology teachers. *Ondokuz Mayis University Journal of Education Faculty, 28*(1), 1-12.

Saka, M. (2019). Evulations of science teachers regarding the classes of school experience and teaching practices. *Elementary Education Online, 18*(1), 127-148. doi:10.17051/ilkonline.2019.527173

Selvi, M., & Yakışan, M. (2004). Misconceptions about enzymes in university students. *Gazi University Journal of Gazi Education Faculty (GUJGEF), 24*(2), 173-182.

Stuckey, M., Hofstein, A., Mamlok-Naaman, R., & Eilks, I. (2013). The meaning of "relevance" in science education and its implications for the science curriculum. *Studies in Science Education, 49*(1), 1-34. doi:10.1080/03057267.2013.802463

Şenol, F. B., Akyol, T., & Can-Yaşar, M. (2018). Teacher candidates' assertiveness levels in terms of different variables. *Journal of Theoretical Educational Science, ICSE-2018*(Special Issue), 146-165. doi:10.30831/akukeg.429106

Talışık, E. (2016). The investigation of relation between perceived professional proficiency, professional satisfaction and burnout levels of in-service music teachers. *Mehmet Akif Ersoy University Journal of Education Faculty, 1*(37), 1-14.

Tas, Y. (2016). The contribution of perceived classroom learning environment and motivation to student engagement in science. *European Journal of Psychology of Education, 31*(1), 557–577. doi:10.1007/s10212-016-0303-z

Tatar, N., & Bağrıyanık, K. E. (2012). Opinions of science and technology teachers about outdoor education. *Elementary Education Online, 11*(4), 883-896.

Tekbıyık, A., & Akdeniz, A. R. (2008). Teachers' views about adoption and application of primary science and technology curriculum. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 2*(2), 23-37.

TIMSS. (2015). TIMSS 2015 International results in science. Retrieved from http://timss2015.org/timss-2015/science/student-achievement/#side

Topsakal, S. (2006). *Fen öğretimi* (Vol. 2). Ankara, TURKEY: Nobel Akademik Yayıncılık.

Toraman, S., & Alcı, B. (2013). Science and technology teachers' opinions about renewed science lesson curriculum. *Ekev Akademi Dergisi, 17*(56).

Töman, U., & Çimer, S. O. (2014). Investigation by skills of pre-service science teachers' reflective thinking from journals. *Journal of Computer and Education Research, 2*(4), 166-190.

Turan, A., & Kocakülah, M. S. (2017). Determination of the levels of selfefficacy beliefs related to the inquiry based teaching of prospective science teachers. *Journal of Theory and Practice in Education, 13*(4), 551-569.

Uzal, G., Erdem, A., & Ersoy, Y. (2015). A study on teaching activities performed by a group of mathematics and science teachers in classrooms. *Buca Faculty of Education Journal, 40*, 64-85.

Ünal, A., & Kılıç, M. S. (2016). Analysis of pre-service science teachers' anxiety situations towards laboratory. *The Western Anatolia Journal of Educational Sciences (WAJES), 7*(14), 21-32.

Yalçın, P., Altun-Yalçın, S., Akar, M. S., & Sağırlı, M. Ö. (2018). The effects of teaching applications with real life content on the levels of pre-service teachers' abilities to associate daily life with astronomy and electrical learning topics. *Pegem Journal of Education & Instruction, 8*(2), 229-252. doi:10.14527/pegegog.2018.010

Yazıcı, E. K., & Özmen, H. (2015). The view of teachers about applicability of activities and experiments found in science and technology curriculum. *Amasya Education Journal, 4*(1), 92-117.

Yeşilyurt, E. (2012). Measurement and assessment methods used at science and technology lesson and the difficulties encountered. *Turkish Studies, 7*(2), 1183-1205.

Yeşilyurt, E. (2013). Assessment of learning environments of pre-service teachers in terms of constructivist approach (an education faculty sample). *Gazi University Journal of Gazi Education Faculty (GUJGEF), 33*(1), 1-29.

Yıldırım, A., & Şimşek, H. (2016). *Sosyal bilimlerde nitel araştırma yöntemleri* (Vol. 10). Ankara, TURKEY: Seçkin Yayıncılık.

Yıldırım, E. G., Köklükaya, A. N., & Aydoğdu, M. (2016). Teaching methods and techniques preferences of the science teacher candidates and reasons of this preference. *e-Kafkas Journal of Educational Research, 3*(1), 15-25.

Yıldırım, M., Sürmeli, H., Benzer, E., & Şahin, F. (2007). The assessing of thoughts of prospective science teachers about teaching profession. *Marmara University Atatürk Education Faculty Journal of Educational Sciences, 25*(25), 185-196.

Yin, R. K. (2018). *Case study research and applications design and methods* (Vol. 6). USA: Sage Publications.

Yurdatapan, M., Benzer, E., & Güven, İ. (2014). Evaluation of healthy lifestyle behaviours of science teaching students. *Journal of Milli Eğitim Education and Social Sciences, 44*(201), 183-202.

Appendix-1 Semi-structured observation form

FIRST PART			
CONTENT KNOWLEDGE			
Observed Behavior	Inadequate (1 point)	Acceptable (2 points)	Well-trained (3 points)
1- Knowledge of basic principles and concepts in the subject			
2- Relating basic principles and concepts with a logical coherence			
3- Using verbal and visual language (figure, scheme, graph, formula and so on) relevant to the subject appropriately			
4- Relating the subject with other subjects in the content area			
PEDAGOGICAL CONTENT KNOWLEDGE			
Observed Behavior	Inadequate (1 point)	Acceptable (2 points)	Well-trained (3 points)
6-Making use of instructional technologies			
7- Identifying students' misconceptions			
8- Giving appropriate and adequate answers to students' questions			
9- Securing the learning environment			
PLANNING INSTRCUTIONAL ACTIVITIES			
Observed Behavior	Inadequate (1 point)	Acceptable (2 points)	Well-trained (3 points)
11- Stating the goals and target behaviors clearly			
12- Identifying appropriate methods and techniques for target behaviors			
13- Selecting and preparing appropriate tools and materials			
14- Identifying appropriate assessment methods for target behaviors			
15- Relating the subject with previous and following lessons			
SECOND PART			
Observed Behavior	Explanations		
1- Mastery in content knowledge and pedagogical content knowledge			
2- Ability to get to know students and approach to students			
3- Creating appropriate learning environment			
4- Assessment of student achievement			
5- Lesson planning and practice			
6- Professional attitude and approach to values			