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A Study on the Effect of Decision-Making Skills Instruction Supported with Socio-Scientific Topics on Pre-Service Science Teachers'the Decision-Making Skills

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Abstract: This study was conducted using mixed method to investigate and improve the decision-making skill competencies of pre-service science teachers. The study was conducted in the fall semester of the 2022-2023 academic year with pre-service teachers studying in the third year of Kastamonu University, Faculty of Education, Science Teacher Education. The study was conducted with a total of 13 pre-service teachers, 9 female and 4 male. Participant pre-service teachers were given an 8-week training and the reflection of this training on pre-service teachers was evaluated. During the training process, prospective teachers were allowed to experience the decision-making process through scenarios supported by socio-scientific issues. As data collection tools in the study, semi-structured interviews were conducted to determine the pre-service teachers' knowledge about decision-making skills at the beginning of the process and at the end of the process to evaluate the change in their decision-making skills with the reflection of the process on themselves, and the Decision Making Skills Test (DMST) adapted by Bozkurt (2014) for pre-service teachers was applied as pre-test before the process and post-test after the process. The quantitative data obtained were analyzed with SPSS program. As a result of the study, it was observed that the students' posttest mean scores (7.18) were higher than their pre-test mean scores (3.13) and this difference was significant. When the findings obtained from the interviews were analyzed, it was determined that the research process contributed to the pre-service teachers' decision-making skills, increased their awareness of decision-making skills, and they experienced conscious changes in the decision-making process.

Keywords: Decision making skills, socio-scientific issues, preservice teacher

Sosyobilimsel Konularla Desteklenmiş Karar Verme Becerisi Öğretiminin Fen Bilimleri Öğretmen Adaylarının Karar Verme Becerileri Üzerine Etkisine Yönelik Bir Çalışma

Öz: Bu çalışma, fen bilimleri öğretmen adaylarının karar verme beceri yeterliliklerini araştırmak ve geliştirmek amacıyla karma metot kullanılarak yürütülmüştür. Çalışma 2022-2023 eğitim öğretim yılının güz yarıyılında, Kastamonu Üniversitesi Eğitim Fakültesi Fen Bilgisi Öğretmenliği üçüncü sınıfta öğrenim gören öğretmen adayları ile gerçekleştirilmiştir. Çalışma, 9 kadın ve 4 erkek olmak üzere toplamda 13

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öğretmen adayı ile yürütülmüştür. Katılımcı öğretmen adaylarına 8 haftalık bir eğitim verilerek bu eğitimin öğretmen adaylarına yansıması değerlendirilmiştir. Eğitim sürecinde sosyobilimsel konularla desteklenmiş senaryolar üzerinden öğretmen adalarının karar verme sürecini deneyimlemesine olanak tanınmıştır. Çalışmada veri toplama araçları olarak; sürecin başlangıcında öğretmen adaylarının karar verme becerisine yönelik bilgilerini belirlemek için ve sonunda ise sürecin kendilerine yansıması ile karar verme becerilerinde gerçekleşen değişimi değerlendirmek için yarı yapılandırılmış görüşmeler, Bozkurt (2014) tarafından öğretmen adayları için uyarlanan Karar Verme Beceri Testi (KVBT) süreç öncesi ön test ve süreç sonrası son test olmak üzere uygulanmıştır. Elde edilen nicel veriler SPSS programıyla analiz edilmiştir. Araştırma sonucunda öğrencilerin KVBT için son test puan ortalamalarının (7.18), ön test puan ortalamalarından (3.13) yüksek ve bu farkın anlamlı olduğu görülmüştür. Görüşmelerden elde edilen bulgular incelendiğinde araştırma sürecinin; öğretmen adaylarının karar verme becerisine katkı sağladığı, karar verme becerisine yönelik farkındalıklarının artmasını ve karar verme sürecine yönelik bilinçli değişimler yaşadıkları belirlenmiştir.

Anahtar kelimeler: Karar verme becerisi, sosyobilimsel konular, öğretmen adayı

Introduction

In the 21st century, individuals are expected to possess a wide range of skills and competencies (Eryılmaz & Uluyol, 2015). Such individuals critically examine and question the information they encounter, approach problems with original thinking to identify the most effective solutions, and generate new knowledge. They actively apply the knowledge and skills they have acquired in real-life contexts, think critically and creatively, communicate effectively, and demonstrate a strong sense of teamwork and responsibility. Moreover, they are entrepreneurial, empathetic, closely follow technological advancements, adopt a global perspective, defend their rights, uphold democratic values and freedom, protect the environment, and actively engage in diverse fields such as science, art, and sports. They are also equipped with sound decision-making abilities and are committed to continuous self-improvement and renewal (Anagün & Atalay, 2017; Jacobs & Klaczynski, 2005; Kurbanoğlu & Akkoyunlu, 2001; Marin & Racipient, 2011; Ministry of National Education [MoNE], 2018; Özmete, 2008; Ridwan et al., 2017).

In the contemporary educational and training objectives of societies, the cultivation of 21st century skills holds a prominent place. Of particular significance is the cultivation of life skills, which are instrumental in fostering individuals capable of making informed decisions, coping with stress, problem-solving, and developing skills that will benefit both themselves and their environment (Turgut, 2019). Therefore, decision-making is regarded as a crucial skill that individuals must develop, making it essential to cultivate this ability in individuals (American Association of Colleges and Universities [AACU], 2007; International Society for Technology in Education [ISTE], 2007). Education systems should be renewed at a level that can raise individuals with the desired skills in order to meet this need of societies (Selçuk, 2019).

In our country, necessary revisions have been made to the curriculum in order to raise individuals with the mentioned competencies and skills. For example, a close examination of the science curriculum reveals that it encompasses six distinct skills that fall under the umbrella of life skills (MoNE, 2018). These skills include analytical thinking, creative thinking, teamwork, entrepreneurial skills, communication skills, and decision-making skills. Researchers draw

attention to the positive effects of life skills training on students, such as stress management, improvement in mental and physical health, and improvement in social behavior (Mishara & Ystgaard, 2006; Sukhodolsky et al., 2004). Torun (2015) states that students' success levels are directly proportional to the high-level cognitive skills they develop in their education and daily lives.

Decision-making, a fundamental component of life skills, has been defined by various researchers. It involves identifying an individual's goals to address a particular need, gathering relevant information, generating alternative options through the evaluation of this information, and selecting the most suitable option to achieve the desired goal (Güçray, 2001). Similarly, Pekdoğan (2015) defines decision-making as determining the information necessary for the realization of the individual's need situation and the targeted result formed for this situation, creating various alternatives for the solution, and choosing the most appropriate alternative that meets the expectation. Sağır (2006) defines decision making as collecting the necessary information to reach the intended result despite the problems and problems that prevent the individual, creating options that are suitable for reason and logic through this information, and determining and applying the most appropriate option that solves the problem. In general, researchers define decision-making as the process of selecting the most appropriate alternative from a set of possible choices that will lead the decision-maker to a goal. This process is objective and based on logic, and it involves trying various ways to achieve the desired result (Gömleksiz & Kan, 2007; Köse, 2019; Tekin & Ulaş, 2016).

Definitions of decision-making highlight its complex and interdisciplinary nature, extending beyond a simple action (Shafir & Tversky, 1992). In the literature, decision-making has been defined by various fields, including psychology, education, economics, politics, medicine, and engineering. While these definitions are largely similar, they tend to have clear boundaries (Adal, 2019). Furthermore, it is evident that decision-making definitions emphasize two primary approaches: outcome and process (Deniz, 2002; Ersever, 1996).

The outcome-oriented approach is based on the idea that predicting the consequences of a decision at the end of the process can provide insight into the decision-making process. In contrast, the process-oriented approach emphasizes that a detailed understanding of the changes occurring throughout the decision-making process reveals how decisions can be made most accurately.

It is emphasized that while decision-making does not have a complex structure in daily life, it requires a complex process in decisions made using scientific methods (Batçıoğlu Genç, 1994). This complex decision-making process includes research-investigation, examination, determining options, predicting the results of the options, choosing the most appropriate one, and making decisions that will solve the problem situation in the most effective way.

Many researchers define decision-making as a process consisting of sequential stages (Hartoonian & Laughlin, 1997; Koçel, 2003). Individuals begin to experience a decision-making process when a problem situation arises, especially in daily life (Deniz, 2002). Subsequently, it is realized by choosing the appropriate decision for one's goal and putting it into action. After a decision is made, the individual undergoes an evaluation process regarding the decision. This process is a cognitive one, aimed at determining which alternative is most likely to achieve the desired goal among the available options (Kardaş, 2013; Tatlılıoğlu, 2014). Individuals' developmental characteristics affect the steps involved in decision-making processes or the details

of the steps used. As an example, Demirbaş-Nemli (2018) suggests that it is more appropriate for first- and second-grade primary school students to use a four-step decision-making process, while third- and fourth-grade students should utilize a five-step decision-making process. The individual's decision-making process starts with recognizing and defining the problem to be decided. In order to create alternatives for solving the problem, the necessary information must first be collected. During the information-gathering stage, the individual examines the data obtained from various sources in a manner that aligns with their goals and priorities. If necessary, they organize and integrate the information. Following this, they generate different alternatives to solve the problem using the gathered information and conclude the process by selecting the most suitable option (Mert, 1997). Decision-making is a process experienced by every individual (Dinç, 2000).

Decision-making, encountered in all fields, holds significant importance, particularly at every stage of the educational process. It is not a skill that can be acquired through a single course or merely by reading books on decision-making (Ortahisar, 2021). To truly internalize this skill over time, individuals must undergo various experiences and be repeatedly exposed to decision-making situations. Training and practices aimed at developing decision-making skills should be consistently integrated throughout students' educational journey, without any distinction between disciplines (Nardi & Wales, 1985). There are many studies in the literature improving decision-making skills (Çimşir, 2019; Esen 2019; Karcılı, 2022; Lee, 2007; Mettas, 2011; Sever, 2018). Moreover, it can be said that decision-making skills can be acquired and developed through education. Gresch and Bogeholz (2013) emphasized that it is important to provide training on the decision-making process because students who do not receive the necessary training cannot manage the decision-making process correctly and are likely to make mistakes. In particular, socio-scientific topics used in the process of these trainings are among the most used topics due to their positive features, such as creating a discussion environment and experiencing the decision-making process (Demiral & Türkmenoğlu, 2018). Within the framework of the curriculum, it is mentioned that decision-making skills should be gained through socio-scientific issues (MoNE, 2018). Sakamoto et al. (2021) concluded that the implementation of the study conducted to improve students' decision-making skills in socio-scientific issues was positively effective.

Upon examining the studies, the importance of developing decision-making skills in relation to socio-scientific issues is emphasized. Hamidah, Liliawati & Putri (2023) found that students' decision-making skills on socio-scientific issues related to climate change should be improved. In addition, Alred and Dauer (2020) concluded that a structured decision-making tool was positively effective in the decision-making processes of undergraduate students. This indicates that decision-making skills can be enhanced through engagement with socio-scientific issues.

Developing decision-making skills through science courses will help both understand the content of the course and develop the skill as a process (Covitt et al., 2013; Jho et al., 2013). Badeo and Duque (2022) examined the research findings on the use of socio-scientific issues in science education. Upon examining the results, it was found that incorporating socio-scientific issues into science education had a significant impact on the development of decision-making skills. The decision-making process plays a crucial role in science education (Zeidler et al., 2005). Indeed, science teachers responsible for managing this process are expected to understand the nature of science education and possess the competencies required for the current age (Akar, 2019).

Specifically, the education provided to pre-service teachers, who will equip students with the skills and qualifications necessary for society, is of great importance.

This study aimed to assess the competencies of pre-service science teachers regarding decision-making skills and processes. In this context, the training program designed for decision-making skills and processes allowed pre-service teachers to experience the decision-making process on socio-scientific issues. The focus of the study was to examine the reflection of the training program designed to develop decision-making skills on the decision-making competencies of pre-service teachers as a result of the process.

Studies on Decision Making Skills

In order to ensure social development, individuals need to have certain skills. It is often emphasized that individuals who are considered successful should have decision-making skills. Individuals with analytical skills who can create alternatives for the problem situation they face, make decisions to solve the problem, implement the decision, evaluate the results of the decision, and make inferences are described as individuals with decision-making skills. Decision-making skills are included in the curriculum under the heading of life skills to be acquired. Gaining reasoning and decision-making skills through socio-scientific issues has an important place (MoNE, 2018). This change in educational goals over time has led to an increase in interest in decision-making skills.

The literature reveals that various studies have explored the impact of different learning environments on the level and development of decision-making skills among both teachers and prospective teachers (Ayaz, 2019; Bozkurt, 2014; Cebesoy, 2014; Goloğlu, 2009; Kardaş, 2013; Türkmenoğlu, 2018). Researchers emphasized that current, socio-scientific issues that provide the opportunity to create a discussion environment can be used in examining the steps of the informed decision-making process (Kılınç et al., 2017). Karcılı (2022), in his study with secondary school students, recommends examining decision-making skill levels in socio-scientific issues by using scenarios that vary by grade level and topic within the study group. In this context, the use of such scenarios in the pre-service teacher education program during the research process, with a focus on socio-scientific issues, enhances the significance of the study.

In recent years, there have been few studies examining the effects of programs designed to improve decision-making skills (Ortahisar, 2021). The training given to pre-service teachers on decision-making skills during the research process has an effect that increases the importance of the research. The fact that pre-service teachers, who should have decision-making skills, experience the decision-making process through the practices carried out in the training process of the research positively affects the importance of the study.

The studies reviewed indicate that quantitative and mixed methods were generally preferred in selecting the research methodology (Ayaz, 2019; Bozkurt, 2014; Cebesoy, 2014; Filiz, 2020; Goloğlu, 2009; Kardaş, 2013; Ortahisar, 2021; Türkmenoğlu, 2018), with qualitative studies being in the minority (Yağcı, 2022). The samples in these studies primarily consisted of pre-service teachers from various disciplines, science teachers, and students at different educational levels. Most of the studies involved large samples. Given the quantitative and mixed-method approaches, it was found that scales and questionnaires related to decision-making skills and decision-making styles were frequently used as data collection tools. In contrast, interviews were less commonly employed in these studies (Cebesoy, 2014; Türkmenoğlu, 2018).

The research results indicate that the decision-making skill levels of pre-service teachers are generally at a low to medium level (Filiz, 2020; Ortahisar, 2021; Sakallı, 2019; Türkmenoğlu, 2018). It was noted that decision-making skills can be enhanced through various learning environments (Ayaz, 2019; Bozkurt, 2014; Goloğlu, 2009; Kardaş, 2013). Additionally, it was emphasized that individuals' cognitive structures play a crucial role in the decision-making process (Yağcı, 2022).

As a result of the literature review, a mixed-method study was chosen to provide more detailed information. While pre-service science teachers were included in previous studies, it was deemed appropriate to focus this research specifically on pre-service science teachers, given the limited number of studies in this particular area. There are not enough studies that include the educational process to improve pre-service teachers' decision-making skills. The fact that pre-service teachers, who should have decision-making skills, experience the decision-making process through the applications carried out in the training process of the research positively affects the importance of the study. In addition, the fact that the scenarios in the training program are especially focused on socio-scientific issues increases the importance of the study in terms of having a positive effect on developing individuals' decision-making skills. Within the scope of this study, the current situation of pre-service teachers was examined in detail by choosing a mixed method.

Purpose of the Study

This study aimed to determine pre-service science teachers' competencies in decision-making skills and processes. In this context, the training program designed for decision-making skills and processes allowed pre-service teachers to experience the decision-making process on socio-scientific issues. The focus of the study was to examine the reflection of the training program designed to develop decision-making skills on pre-service teachers' decision-making competencies as a result of the process. The research questions to be answered in this study are as follows:

1. How are the level of pre-service science teachers' decision-making skills in socio-scientific issues?

2. Has individual change and development occurred in pre-service teachers as a result of the training?

Method

Research Design

The research model of this study was determined as mixed method. Mixed method approach is used in cases where it is determined that qualitative or quantitative methods alone will be insufficient in analyzing the research problem (Creswell & Plano Clark, 2011). In this particular research, qualitative data are more important than quantitative data. Qualitative and quantitative data were collected simultaneously and analyzed separately, and the data obtained will be combined in interpreting the results of the research. In the nested embedded design, data can be collected simultaneously or sequentially. Data are collected independently of each other and analyzed independently. However, these analyses are combined in interpretations. What is important is that one qualitative or quantitative data supports the other. In this design, a quantitative method can be included in a qualitative case study (Creswell, 2012). For this reason, it was determined that the study should be conducted as an embedded design from mixed method designs.

The qualitative aspect of the study was planned as a case study and the quantitative aspect, which played a supporting role, was designed as a simple experimental design.

Case Study

In qualitative studies such as case studies, it is usually possible to study in depth and in detail on a small number of individuals or a single situation/event (Patton, 2002). In the research process, it was aimed to examine pre-service teachers' decision-making skills competencies in depth. Case study involves the selection of a situation and in-depth analysis of this selected situation (Creswell, 2016). For this reason, semi-structured interviews were conducted with pre-service teachers. This situation can be shown as the reason why the qualitative aspect of the study was determined as a case study.

Simple Experimental Design

The quantitative aspect of the study was conducted with a one-group pretest-posttest experimental design method to determine the effect of decision-making skills training supported by socio-scientific issues on pre-service teachers in the process. The experimental design method aims to reveal the cause-and-effect relationship between variables (Sümbüloğlu, 1988). There is no control group in the simple experimental design method used in this study. It is aimed to examine the effect of the variables determined over a single group. The change and development of the group participating in the experiment is observed by using pre-test and post-test. If the pre-test and post-test measurements are compared and there is a significant difference between them, the study is determined as effective (Karasar, 2002).

In order to keep the internal validity of the research high, the pre-service teachers participating in the research were preferred from the 3rd grade level because they were accustomed to university conditions and were not in the graduation period. In this case, they were prevented from being affected by variables outside the research. The research was completed in a relatively short period of 8 weeks and it was aimed to prevent the candidates from getting used to the process. It was aimed to strengthen internal validity by keeping the pre- and post-test durations the same.

Study Group

In the fall semester of the 2022-2023 academic year, 13 pre-service teachers from the third year of the Department of Science Teaching, Faculty of Education, Kastamonu University, who were enrolled in the Science Teaching-1 course and voluntarily participated in the study, were selected as the study group. The group consisted of nine female and four male pre-service teachers. The decision-making skill, which is the focus of the study, is part of the Science Teaching-1 course curriculum. Therefore, the study was conducted with third-year students who were actively enrolled in this course.

Data Collection Tools

Decision-Making Skills Test

In this study, the Decision-Making Skill Test (DMST) adapted by Bozkurt (2014) for pre-service teachers from the decision-making skill test developed by Ercan and Bozkurt (2013) for primary school students was used to determine the decision-making skill levels of pre-service teachers. The DMST, developed to assess an individual's decision-making skill level in various real-life situations, consists of 11 multiple-choice questions. Each question offers six possible

answers, with only one correct response. According to Bozkurt (2014), the test includes three easy, five medium, and three difficult items, with an average difficulty level of 0.52. The KR-20 internal consistency coefficient for the sample group was found to be 0.71. The DMST was administered within a 30-minute time frame. Each correct answer was awarded 1 point, while incorrect answers, responses with multiple selections, or unanswered items received 0 points. The highest possible score on the DMST is 11, and the lowest is 0.

Semi-Structured Interview

At the beginning of the implementation process, the definition, development, and evaluation of decision-making skills were determined as the main themes. Then, semi-structured preliminary interviews were conducted to explore the knowledge and perceptions of the pre-service science teachers participating in the study about these concepts. After the completion of the applications, semi-structured final interviews were conducted. The researcher asked questions such as 'Why? How?" to elaborate on the answers given to the interview questions. The pre-post interview questions prepared by the researcher were submitted to expert opinion. After the expert opinion, was given, necessary corrections were made, and the questions were finalized.

In this research process, pre-interviews with the pre-service teachers participating in the study were conducted in an average of 8 minutes and post-interviews were conducted in an average of 40-45 minutes. The extended interaction between the researcher and participants is one of the factors that enhances the validity of qualitative research (Creswell & Miller, 2000). Therefore, the 8-week duration of the research allowed the researcher to gain a detailed understanding of the pre-service teachers. During this period, in-depth analyses were conducted in line with the case study approach, and the results were interpreted accordingly.

Training Plan

The training plan, pre-post interview program, and interview questions were prepared by the researcher and submitted to expert opinion. After the evaluation of the experts, the researcher made the necessary corrections in line with the feedback received. After the revisions of the questions to be used for the pre-and post-interviews and the training plan, the planned implementation started. Table 1 shows the training plan implemented in the study. The table includes the planned implementation weeks for a total of eight weeks, the duration of the implementation, content/subject, activities, and the dates realized.

Table 1

Training Plan

Implementation Week	Implementation Time	Subject	Activities
Week 1		Preliminary Interview DMST pre-test	
Week 2	3 Class Hours	Defining decision-making skills	Discussion
Week 3	3 Class Hours	Steps of the decision-making process	Article reading task and discussion

Week 4	3 Class Hours	Characteristics of an individual with decision-making skills	Article reading task and discussion
Week 5	3 Class Hours	The importance of decision-making skills in science education	Decision-making process activities and discussion through scenarios
Week 6	3 Class Hours	Learning environments that support decision-making skills	Decision-making process activities and discussion through scenarios
Week 7	3 Class Hours	Learning environments that support decision-making skills	Decision-making process activities and discussion through scenarios
Week 8		Last Interview DMST post-test	

The decision-making process activities through scenarios in weeks 5, 6, and 7 were carried out on various socio-scientific topics. The selected scenarios are based on Türkmenoglu (2018) and taken from Gülhan's (2012) master's thesis. The preferred scenario topics in the implementation process were the Human Genome Project, GMO Products, Biotechnology, Human Cloning, Global Warming, Nuclear Energy, and Energy Conservation. Although the socio-scientific scenarios, which required a decision-making process and were intended to enhance decision-making skills, initially posed challenges for the pre-service teachers, it was observed that their control over the topics and the decisions they made improved as the process progressed. One of the example scenarios used in the training is shown in Figure 1.

Figure 1

Sample Scenario

SCENARIO-5: BIOTECHNOLOGY

Biotechnology refers to all methods used to obtain a new organism (plant, animal, or microorganism) by using all or part of a plant, animal, or microorganism, or to make desired changes in the genetic structure of an existing organism. Biotechnology is a term used to describe various techniques and processes applied to understand and modify the functions of human, animal, and plant cells. It encompasses the development of products for the improvement of living organisms or their industrial use, as well as the application of modern technology to the natural sciences. It encompasses the development of products for the improvement of living organisms or their industrial use, as well as the application of modern technology to the natural sciences.

- The production of genetic products for the treatment and prevention of diseases such as cancer and AIDS
- The production of proteins that will address issues such as growth retardation or combat infectious diseases
- The development of transgenic plants that will synthesize recombinant drugs and vaccines
- The repair of damaged brain cells and the spinal cord
- The development of transgenic plants that synthesize recombinant drugs and vaccines

These are examples of biotechnology applications. With its current development, biotechnology facilitates human intervention in nature. Controlling nature will not cause problems as long as it is used in beneficial ways. But what about when it is abused? Serious regulations are being put in place around the world in this regard. For example, practices similar to Hitler's "master race" project will be prevented. In the field of medicine, determining that a person will have a short life span through genetic testing will change that person's life. Knowing who carries certain diseases will affect people's work and choices. Biological weapons that could be released into the environment for various purposes could threaten the health of many people.
(http://biyoinformatik.files.wordpress.com/2007/02/bolum2.pdf).

If you were an authority on biotechnology, what decision would you make? Do you consider biotechnology to be ethical?

Data Analysis

Analysis of Quantitative Data

The research data were analyzed using the SPSS 21 program. In order to determine the analyses to be used in the research, firstly, the number of the sample and whether it shows a normal distribution were determined. Since the sample of the study consisted of 13 people, the Shapiro-Wilk test was used in the normality test. It was seen that the distributions were not normal as expected considering the results in small groups. Since normal distribution was not observed in this study, the Wilcoxon Signed Ranks Test, which is the non-parametric equivalent of the t-test, was conducted to see whether the difference between the pre-post test scores of the Decision Making Skills Test of pre-service teachers was significant.

Qualitative Data Analysis

Inductive qualitative data analysis is a process of coding data and creating themes by establishing the connection between codes (Patton, 2002). For this reason, the semi-structured interviews conducted in the study were analyzed by content analysis. Content analysis, unlike descriptive analysis, requires in-depth analysis of the collected data and the emergence of themes that were not previously identified (Strauss & Corbin, 1999). The interviews recorded with a voice recorder were transcribed by the researcher. The data obtained were read several times by the researcher, analyzed carefully and themes were formed. Coding was done in accordance with the emerging themes. The data were analyzed in four stages: coding the data, creating themes and codes, organizing the themes and codes, and defining and interpreting the findings (Miles & Huberman, 1994). In order to increase the reliability of the research, after the researcher completed

the coding process, the interview data were examined by an expert. In line with the revisions given by the expert, the codes were reorganized twice and finalized.

Findings

DMST Findings from the Pre-Test and Post-Test Analysis

The Decision-making Skills Test was administered to the participants as a pre-test and post-test to see whether there was any change in the level of decision-making skills of the pre-service teachers. Table 2 shows the descriptive statistics of the participants for the pre-test and post-test.

Table 2

Arithmetic Mean, Standard Deviation, Minimum and Maximum Values of Students' Scores from DMST

	n	Lowest score	Highest score	Mean	Standard deviation
Pre-test	13	1	6	3.13	1.154
Final test	13	6	8	7.18	0.831

An analysis of Table 2 reveals that the pre-service teachers' scores on the pre-test ranged from 1 to 6 points, while their scores on the post-test ranged from 6 to 8 points. The mean score of the participants who had a pre-test DMST score of 3.13 was 7.18 after the application. The normality test results of the pre-test and post-test scores of the pre-service teachers are given in Table 3.

Table 3

Normality Test Results of DMST Pre-Test and Post-Test Data

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pre-test	0.241	13	0.026	0.892	13	0.087
Final test	0.192	13	0.170	0.873	13	0.046

Based on the results of the Shapiro-Wilk test, it was determined that the post-test did not show a normal distribution. In this study, the Wilcoxon Signed Ranks Test was conducted to investigate whether the difference between the pre-test and post-test scores of the pre-service teachers was significant. The results are presented in Table 4.

Table 4

Comparison of DMST Pre-Test and Post-Test Scores with Wilcoxon Signed Rank Test

Final Test	Pre-Test		n	Rank Mean	Row Total	*z*	*p*
		Negative Sequence	0	.00	.00	-3.186	.001
		Positive Sequence	12	7.00	91.00		

	Equal	1

As shown in Table 4, the Wilcoxon signed-rank test results indicate a significant difference between the pre-test and post-test averages of the DMST ($p<0.05$).

Since this difference is in favor of the post-test averages ($z=-3.186$), it is obvious that the decision-making skill training process contributed positively to the decision-making skill levels of pre-service teachers.

Pre-Interview Findings of Prospective Teachers

The pre-interview aimed to reveal the pre-service teachers' knowledge of decision-making skills. As a result of the researcher's analysis, "21st Century Skills Awareness, Definitions, Existence of Decision-making Skill, Steps, Individual Characteristics, Development, Measurement of Decision-making Skill Level" themes were formed. The themes, codes, and frequencies obtained as a result of the data analysis are given in Table 5.

Table 5

Themes, Codes and Frequencies Related to Preliminary Interviews

Theme	Codes	Frequency(f)
21st Century Skills Awareness	Does not know	6
	Engineering-design skills	4
	Critical and analytical thinking	3
	Technology literacy	2
	Scientific literacy	2
	Entrepreneurship	1
Definitions	Requiring process	12
	Result-oriented	4
	Selecting/selecting an option	4
	Individual	4
	No process required	4
	Subject dependent	3
	Free expression of choice	2
	Time dependent	2
	Affects an individual's life	2
	It is difficult	1
	Problem solving	1
Presence of Decision Making Skills	Not every individual has	7
	Every individual enjoys	5
	Cannot be evaluated	1
Steps	Outcome-oriented thinking	7
	Create criteria	4
	Making a choice from options	3
	Identifying the source of the problem	2
	Create options	2
	Planning the process	1
	Implementation of the decision	1

	Data collection		1
	Evaluation		1
Characteristics of the Individual	Provides clear answers to questions		6
	Uses gestures and facial expressions		6
	Reflects on life		1
	Confident		1
Development	Can be improved		13
	Must be done	Students' theoretical knowledge should be increased	5
		Democratic environment must be established	4
		Researching	4
		Teacher-student/student-student communication should be ensured	4
		With support from the social environment	3
		Taking responsibility for my decision and its consequences	3
		Over time	2
		By acting decisively	2
		Using logic	2
		By experiencing	1
		Education	1

21st Century Skills Awareness

During the interview, pre-service teachers were asked questions to assess their awareness of 21st-century skills, including their decision-making processes. The analysis led to the identification of several codes, which were categorized under the theme of 21st-century skills awareness.

The analysis of the codes revealed that most of the pre-service teachers participating in the study lacked a comprehensive understanding of 21st-century skills, with their knowledge being largely superficial. The skill most emphasized by the pre-service teachers was engineering-design. When discussing thinking skills, they tended to present critical and analytical thinking in a general and superficial manner. In statements related to science and technology literacy, it became apparent that the pre-service teachers possessed only limited knowledge of the skills they aimed to describe. Specifically, technological literacy was often restricted to the correct use of technology, while scientific literacy knowledge appeared to be confined to the health domain. Examples of pre-service teachers' opinions are given below.

S2: *"It can be using technology correctly. For example... It can be using drugs or biological things correctly and healthily. Like antibiotics for example. As they said that they cannot be used in viruses in the pandemic, you know, it is necessary to use this correctly."*

S6: *"If we think from our department, it requires engineering and design skills. Entrepreneurship skills... That's all I can think of now."*

Decision Making Definitions

All pre-service teachers acknowledge that decision-making involves a process. However, they describe this process as the period between encountering a situation that requires a decision and the moment the decision is made, rather than a series of sequential steps. Additionally, pre-service teachers who assert that decision-making should be result-oriented also emphasize its inherent difficulty. In their responses, those who indicated that decision-making situations vary depending on the issue, and that decisions differ from person to person, define decision-making as having a significant impact on an individual's life. This highlights the importance of possessing strong decision-making skills. Below are sample statements from the pre-service teachers.

S3: *"Decision making is to reach a conclusion in the direction that we think is right or wrong when we have to make a choice about a subject. This is how I define decision making.".*

S2: *"... making a decision is a difficult thing. If it affects one's own life, it is even more difficult, but for example... again, if we look at our daily life, it does not require much process when choosing the food we will eat, but as I said, it may require a long process for our education life, our future, our career."*

S5: *"Decision making is choosing an option or coming to a conclusion about a subject with one's own will."*

Existence Of Decision-Making Skills

Questions were asked to measure pre-service teachers' awareness of the difference between decision-making situations and decision-making skills. The questions focused on whether individuals have decision-making skills in every decision they make.

The pre-service teachers who noted that each decision-making situation is unique, and that moments of reluctance, such as obligations, may arise, argued that individuals may sometimes make decisions that are not aligned with their own priorities. They stated that not every individual possesses decision-making skills. Furthermore, some pre-service teachers expressed the view that an individual's decision-making skills cannot be assessed based on any single decision they make.

However, in the statements of some pre-service teachers, it is noteworthy that the decision-making skill depends on the accuracy of the decision made by the individual. The pre-service teachers who stated that making a decision is sufficient to have decision-making skills emphasized that the individual should take responsibility for the decision he/she makes. Sample statements of pre-service teachers are presented below.

S3: *"...I think we cannot evaluate this with a single decision, you know, we can see it depending on many decisions. I think we can realize that he is a very decisive person... from the consistent development of his decisions. I mean, with a sudden decision... for example, it could be something that was done out of the blue."*

S7: *"People can make wrong decisions, that is, not everyone has the ability to make decisions. Therefore, if we can distinguish right or wrong, people who make wrong decisions do not have the ability to make decisions."*

S6: *"I think he can show it, I think he shows it because he makes his own decision, whether it is positive or negative, it is his own opinion."*

Decision Making Steps

Various questions were asked to determine their level of knowledge of the steps of the decision-making process. Codes were developed to represent the steps of the decision-making process. Upon examining the statements and codes derived from the interviews, it became evident that the pre-service teachers did not fully outline the steps involved in the decision-making process, with only a few steps being emphasized. Additionally, the steps mentioned in their statements lacked detail. Accordingly, it was determined that pre-service teachers did not have sufficient knowledge about the steps of the process.

In particular, it is seen that few pre-service teachers included the step of identifying the source of the problem, which is the first step of the decision-making process, in their statements. This situation indicates that although it is the first step of the process, many pre-service teachers do not see identifying the problem as a step. Examples of pre-service teachers' statements about the process steps are given below.

S1: *"Well, it may require most of the time, you know, first of all, you need to know where the problem comes from, then you need to look at how the events develop, lastly, the whole..."*

S4: *"Of course. First of all, he thinks, then he researches, he has information about that thing, he does research from the necessary sources. As a result of this, he/she makes a decision, whichever is the right result, according to the person."*

S10: *"At the beginning, for example, it is different. What he thinks at the beginning is different, as the process progresses, for example, it is different as he follows something, it can change as a result, so I think it can change in a step-by-step manner. I think it is more accurate to make decisions based on a process rather than a sudden decision."*

Characteristics of the Individual

Overall, when examining the statements of the pre-service teachers, it becomes apparent that the characteristics they highlighted were largely based on individual observation. The necessity for an individual to possess other 21st-century skills was not emphasized. This indicates that the pre-service teachers lacked sufficient knowledge about the characteristics of a decision-making individual.

One of the most frequently mentioned characteristics of the individual was the ability to provide clear answers to questions. Additionally, it was observed that the statements primarily focused on the students' behaviors, gestures, and facial expressions. Furthermore, the statements highlighted that indecision is often reflected in an individual's gestures. Examples of pre-service teachers' thoughts are given below.

S1: *"I mean, he can understand from the answers I give if he speaks clearly. If he/she has made a decision, I say he/she has reached a conclusion."*

S2: *"For example, when I am a teacher, I will ask a science question to a student, a science question does not require indecision, it is either yes or no, but there may be indecision while chatting."* .

S5: *"...I try to guess more or less, I try to observe his/her movements, what he/she thinks... I try to understand from his/her thoughts, speech, movements."*

Development

All of the pre-service teachers stated that decision-making skills can be improved. Then, they were asked to give examples of what can be done to improve decision-making skills. The answers given by the pre-service teachers were analyzed.

To improve decision-making skills, pre-service teachers predominantly suggested enhancing students' theoretical knowledge. They also identified the creation of learning environments aligned with democratic structures as an important step toward improving decision-making skills.

Pre-service teachers particularly emphasized that decision-making skills can be enhanced by reducing the time spent on the decision-making process. It was noted that pre-service teachers who mentioned the use of various methods for research to improve decision-making skills included this perspective in their statements. While they acknowledged that an individual's decision-making skills can improve over time, they also highlighted that the education one receives plays a significant role in this development.

Although a development process over time was mentioned, it was observed that no detailed information was given regarding how this development would take place. Examples of pre-service teachers' statements are given below.

S1: *"...Improving the student about the subject can help him/her make clearer decisions."*

S10: *"I think it can be improved... The process can be reduced. Either he/she is having trouble making a decision, for example, he/she is indecisive... I think this skill can be developed in order to be sure of his/her feelings... In order to improve my decision-making skill; I think books can be read, articles can be read, based on these examples, if more work is done on this, I think I can improve. I mean, reading more can actually improve things in this direction."*

S11: *"I think it is something that can be developed because decision-making skill is something that goes through a mental process and this can be developed through the education they receive. After that... It can change over time within the framework of the information it has acquired in its environment, it can be improved."*

Final Interview Findings of Teacher Candidates Regarding Decision Making

The analysis of the pre-service teachers' findings on decision-making revealed several themes, including definitions of decision-making, steps, characteristics of the individual who makes decisions, learning environments that develop decision-making skills, and the role of the teacher. The themes, codes and frequencies obtained for decision-making are presented in Table 6.

Table 6

Themes, Codes and Frequencies Formed for Decision Making

Theme	Codes	Frequency(f)
Definitions	Process takes	8
	Results must be achieved	5
	Systematic	3
	Skill	2
	Interdisciplinary	1

	Rational thinking	1
	Can be improved with training	1
Steps	Defining the problem/identifying the purpose	6
	Choosing the most suitable alternative	6
	Identify alternatives/options	3
	Collect data	2
	Evaluate	2
	Establish criteria	1
	Implementing the decision	1
Characteristics of the Decision Maker	Critical thinker	5
	Able to evaluate	5
	Analytical thinker	4
	Have the ability to question	3
	Creative	3
	Rational thinker	3
	Self-development	2
	Determined	2
	Science literate	2
	Opinion holder	2
	Conclusive	1
	Creating alternatives	1
	Graspable	1
	Empathic	1
	Productive	1
	Define the problem	1
	Time management	1
Learning Environments that Develop Decision Making Skills	Discussion	9
	Applications in socio-scientific issues	5
	STEM-based activities	2
	Station technique	1
	Game-based learning	1
	Experiment	1
Role of the Teacher	Guidance	3
	Have the ability to ask questions	2
	Offering alternatives	1
	Non-authoritarian	1

Definitions of Decision Making

As a result of the analysis, several codes were identified under the theme of decision-making definitions, the codes “takes a process”, “results should be achieved”, “systematic”, “skill”, “rational thinking”, “interdisciplinary”, “can be developed with education”.

In their views on the definition of decision-making, pre-service teachers mostly emphasized the necessity of process and that decision-making is not an instantaneous action but a process.

Pre-service teachers who mentioned that their understanding of the decision-making process changed after the training process stated that the process should ultimately lead to a conclusion. Their statements emphasized that the decision-maker must possess specific skills, along with the details of these skills. In addition, the necessity of rational thinking was also emphasized.

Decision-making skills are intertwined with many fields by their nature. Especially in the education process, the scenarios in which the pre-service teachers need to reach a decision were chosen from different fields to show that the decision-making process is experienced in many fields. During the interviews, it is seen that the pre-service teachers included in their statements that decision-making is an interdisciplinary process. Examples of pre-service teachers' definitions of decision-making are given below.

S1: *"Decision-making is a process, not just something that happens instantaneously. I mean, it is like a scientific process, an event with mathematics and systematics."*

S2: *"In this training, I learned that decision-making is a process, not just an instantaneous process. Decision making... is a process and affects many interdisciplinary things and goes through certain stages."*

S5: *"A certain process... first we need to have a problem. I think we have to have options for the problem and then reach a conclusion that goes through stages."*.

S11: *"Right now, I can define decision making... as follows: Thanks to decision making, for example, if we think effectively, if we think rationally, we can get a good result in a good way by determining the pros and cons of our criteria. Otherwise, because we don't think for ourselves, because we don't prefer to think too much, we are more influenced by the people around us and we cannot be ourselves as an individual."*

Decision-Making Steps

Some pre-service teachers, after emphasizing the necessity of the decision-making process, immediately defined the steps involved. The process definitions of the pre-service teachers were handled as a separate theme.

When the statements of the pre-service teachers regarding the steps of the process were examined, it was seen that the steps of defining the problem and choosing the most appropriate alternative were especially emphasized.

The pre-service teachers who emphasized the need for the individual to choose the most appropriate alternative stated that their consciousness toward decision-making improved at the end of the training. However, only two pre-service teachers emphasized the data collection step in their statements. Sample statements of the pre-service teachers regarding the process steps are given below.

S2: *"Decision making is a process and affects many interdisciplinary things and goes through certain stages, all of which start with defining the problem."*.

S10: *"At the end of the training... I adopted it better as a result of how decision making can be increased in the classroom or learning environments and the activities we did about it. Decision making is taking the most appropriate option for oneself by considering different options at that moment about any problem. So this is decision making, choosing the most appropriate option."*.

S4: *"I think about decision making by identifying a certain alternative... a problem suitable for ourselves, choosing alternatives and deciding which one... whichever of the options is the most suitable for us and evaluating the results."*

Characteristics of the Decision-Making Individual

During the interview, pre-service teachers were asked to define the characteristics of an individual with decision-making skills. The analysis resulted in the identification of several codes under the theme of the characteristics of the decision-maker, including "able to think critically", "able to evaluate", "able to think analytically", "having questioning skills", "creative", "rational thinker", "able to improve himself/herself", "determined", "science literate", "having ideas", "able to reach conclusions", "creating alternatives", "empathetic", "productive", "able to define the problem", "having time management".

It was observed that pre-service teachers emphasized that the individual who makes decisions has the characteristics of critical thinking and evaluation. In addition, if a decision-making individual cannot evaluate the options at hand, the decision-making process will not reach the desired result. For this reason, it was determined that the ability to evaluate, which has an important place in the characteristics of an individual with decision-making skills, was frequently included in the statements of the prospective teachers. Sample statements expressing the characteristics of an individual with decision-making skills are given below.

S1: *"I think a person who can think creatively, criticize, look at things from different perspectives, choose the best option and do it in a certain amount of time, not too broadly."*

S3: *"...I define them as individuals who have questioning skills, can make comparisons, think rationally, and can analyze options correctly.".*

S11: *"Someone who has decision-making skills is an individual who is effective, who takes into account the criteria, evaluates those criteria within himself/herself, creates an alternative, and as a result of the alternative, reaches a good and self-serving conclusion."*

S2: *"...first of all, he/she is scientifically literate and knows science well, then... he/she has knowledge about many subjects and... he/she is competent... he/she knows himself/herself and evaluates himself/herself accordingly when making a decision. He/she goes through various ways.".*

S8: *"First of all, he should be a determined person, he should be productive, he should know the value of science, you know, he should have knowledge in many ways... he should think critically, think analytically.".*

Learning Environments That Develop Decision-Making Skills

Under the theme of learning environments that improve decision-making skills, the codes "discussion", "applications on socio-scientific issues", "STEM-based activities", "station technique", "game-based learning" and "experiment" were created.

In the statements regarding the developing learning environments, it was observed that pre-service teachers frequently emphasized discussion-based practices, which are most frequently used to develop decision-making skills. In these statements, the necessity of focusing on the topics that students can discuss in the discussion environment created was especially emphasized. S1 clearly stated this situation with the following sentences: *"I think it is most important to teach the lesson*

as a discussant. It is important to ask the right questions to children and to show them the options from different angles. I think discussing is the most important thing.". A similar example was given by S5: *"First of all, a discussion environment should be created in the classroom. The teacher should choose questions in a way that students can discuss and find topics to discuss and give students the opportunity. In this way, decision-making skills develop."*.

In their statements, pre-service teachers indicated that the integration of socio-scientific issues into learning environments can support the development of decision-making skills. They also suggested that engaging students in scenario-based discussions on socio-scientific issues during the educational process can serve as an effective strategy to foster these skills. For example, S10 said, *"We have already done many things. Thinking about socio-scientific issues daily... Talking about the problems in our daily lives and discussing them in the classroom environment, not coming up with ideas about it. Which of these can be suitable for us."*

During the study process, the aim was to observe the development of decision-making skills by conducting discussions on socio-scientific issues with pre-service teachers. However, although these learning environments were not utilized during the implementation process, references to various alternative environments were identified in the statements. It was concluded that the pre-service teachers mentioned these environments—believed to enhance decision-making skills—based on their experiential learning rather than through a deliberate or theoretical understanding. Additionally, some pre-service teachers specifically referred to STEM-based activities, such as *prototype production*, as part of their suggested approaches. For example, S7 stated this situation with the following sentences: *"A discussion environment can be created in the classrooms. Instead of certain... or more verbal topics, I can enable them to produce a prototype and make an evaluation on it."*

The Role of the Teacher

In their statements, the pre-service teachers not only identified learning environments that support the development of decision-making skills but also highlighted the essential characteristics that teachers should possess. The analyses derived from these statements were categorized under the theme of "the role of the teacher". Within this theme, the following codes were identified: "guidance", "having the ability to ask questions", and "not authoritarian".The statements include references to the teacher's role as a guide, particularly in selecting discussion topics that engage students and in promoting a student-centered educational approach. Additionally, in statements emphasizing that the core of a decision-making issue or situation should be identified through appropriate questioning, it is highlighted that the teacher must possess strong questioning skills.

Furthermore, in their statements, pre-service teachers emphasized that teachers should avoid adopting an authoritarian attitude in order to foster the development of decision-making skills. They highlighted the importance of ensuring that students remain active participants throughout the process and that activities are designed to be student-centered. Sample statements of pre-service teachers are given below.

S5: *"First of all, a discussion environment should be created in the classroom, the teacher should choose the questions in a way that students can discuss and find topics to discuss and give students the opportunity. Generally, it should be a student-centered education."*

S8: *"First of all, the right question should be asked about the subject, because this is the most crucial thing. Then... In the process of helping them make decisions by asking different questions according to the answers. I think so."*

S6: *"The lesson can be taught by creating a discussion environment rather than an authoritarian teacher. As a process environment where students are active... The activity process can be created by considering the students in the activities and taking their emotional state into consideration."*

Findings of the Final Interview Regarding the Evaluation of Pre-service Teachers' Education

The themes, codes and frequencies obtained for the evaluation of the training are given in Table 7.

Table 7

Themes, Codes and Frequencies Formed for the Evaluation of the Training

Theme	Codes	Frequency(f)
General evaluations on education	Satisfaction with the training process	13
	Creating a discussion environment	2
	Different educational process experience	1
	Student-centered	1
Contributions to the individual	Change in the decision-making process	9
	Individual awareness	7
	Inquiry	5
	To be able to evaluate	2
	Improving decision-making skills	2
	Rational process development	2
	Developing foresight for the future	2
	Self-discovery	1
	Freedom of expression	1
	Retrospective evaluation	1
	Take responsibility for the decision	1
Benefits of activities (scenario-discussion)	Satisfaction with event processes	12
	Gain different perspectives	7
	Living the process of questioning	6
	Improving decision making	4
	Developing forward-looking professional vision	3
	Awareness raising	2
Challenges in the education process	Difficulty making decisions	4
	Moving to a more difficult level every week	3
	Different education process	2
	Difficulty of the selected subjects	1

General Evaluations On Education

In the interviews, pre-service teachers expressed their satisfaction with the training process. The democratic structure of the discussion environment established during the training process

where pre-service teachers were encouraged to express their opinions was frequently mentioned in their statements. S3 explained this situation with the following sentences: *"I think it went well. You and the instructor created such a thinking environment in the classroom. I approved or disapproved of my friend's opinion. It was the same for me. For this reason, I think it was nice and useful."*.

In addition, the pre-service teachers, who noted that the training process differed from their previous educational experiences, highlighted several positive aspects in their statements. These included the benefits of coming prepared for the training and the student-centered nature of the process, which they viewed as a significant strength. S5: *"The training process was good, and it was really student-centered. It was very different from the education processes we have experienced so far. It was a process in which we were able to think and analyze ourselves."* reflected this situation.

Moreover, the pre-service teachers who mentioned experiencing individual awareness as a result of the training also indicated that the process contributed to the development of their professional vision for the future. For example, S1 stated this as follows: *"The training process was really good because we really became aware of many things. We realized how we make decisions and how we should not make decisions. I mean, it is important to grasp the system of the event. It was useful; it taught us to look at things from different perspectives. It taught me to evaluate options; I mean, I even saw something about how I will teach in the future."*

Contributions to the Individual

In their statements about the contributions of the training process to the individual, the pre-service teachers indicated that there was a change in their decision-making processes. In particular, pre-service teachers who reported undergoing an evaluation process for their previous decisions indicated that they frequently experienced indecision prior to the training; however, following the training, they demonstrated a tendency to act more decisively. Examples of pre-service teachers' thoughts are given below.

S6: *"It was positive for me. As I said, something I did unconsciously before in decision making, now I do it more consciously. By questioning before, saying 'Why did I do this? It also guided my future and created an impression in my past."*.

S8: *"How can I say it happened? As I said, I can proceed more healthily in the decision-making stages in the progression process. For example, I do not skip one stage and move on to the next. I will always proceed by thinking and evaluating each stage while making decisions."*

S9: *"I was undecided before, before taking this course, how to do what to do, but after taking this course, it showed me the right way to find the right path, it taught me to stand behind my decision, to make the right decision, to ask the right questions."*

Benefits of Activities (Scenario-Discussion)

During the training process, scenarios and discussion processes on different socio-scientific issues were evaluated by the pre-service teachers. Satisfaction with the training activities was frequently mentioned in the statements.

The pre-service teachers emphasized positive aspects in their statements, including the gradual progression of activities throughout the process, the opportunity to voice their opinions

during the training, and the enhancement of their decision-making skills as a result of the activities included in the training. Some pre-service teachers mentioned that they gained individual awareness thanks to the activities in the training. Examples of pre-service teachers' opinions are given below.

S5: *"It was useful because it made us think and we were given the right to speak, it was good for me in the class, it was not something that was too much of an obligation for me, honestly, we were reading, we were discussing. That's it."*

S4: *"It was useful. It was useful in the sense that I realized that I was actually overlooking some things while I was criteriaing the scenarios according to myself. I observed this by discussing it during the lesson. I learned that I should be more careful now."*

S7: *"I definitely think it was effective. Either there... your intervention at the points we missed, your saying 'Why didn't you think of it like this?' really led us to think, so I think it was effective."*

Challenges in the Education Process

The pre-service teachers mentioned the difficulties they experienced during the education process in their statements. Regarding decision-making on socio-scientific issues, some pre-service teachers expressed challenges in reaching a decision. It is noteworthy that these difficulties were sometimes attributed to the subject matter and at other times to the cognitive demands of the thinking activity involved.

S8: *"A little bit yes because these subjects are a little bit.... How can I put it? I mean, the subjects that I had no right to speak seemed like very high level subjects. It could have been more like this, for example, I think there could have been decisions related to education or decisions where I could have more say."* while indicating the subject source; S12: *"It is difficult for me... I mean, every week I felt as if I was put one click on it, it gets deeper and deeper, and decision-making becomes more and more difficult. I need to think more like this. About what I should do. That's exactly what I felt, I mean really."* emphasized the act of thinking.

Discussion, Conclusions, and Recommendations

Results and Discussion on Pre-service Teachers' Decision-Making Skills and Their Development

As a result of the studies, an increase was observed in pre-service teachers' decision-making skills. This difference in pre-service teachers emerged as a result of the interviews conducted by the researcher and the Decision-making Skills Test. When the pre-test results of the Decision-making Skills Test were examined, it was determined that the average decision-making skill of the pre-service teachers participating in the study (3.13) was at a low level. Consistent with the findings of this research, the study conducted by Sevgi (2016) with 7th grade students also revealed that the pre-test results of the DMST were at a low level.

In contrast to the findings of this study, Bozkurt (2014) assessed the decision-making skills of pre-service science teachers (n=36) using the DMST and found that the pre-test results were at a moderate level (6.64). The DMST measures individuals' decision-making skills at the rational style level, and it can be inferred that this difference may be attributed to the variation in sample size and group characteristics. Upon examining the pre- and post-test results of the study, a

significant improvement in favor of the post-test was observed. This outcome aligns with the results of other studies (Bozkurt, 2014; Sevgi, 2016). In addition, since there is no control group in quantitative data analysis, this study is limited to the pre-post test comparisons of the 13 pre-service teachers who participated in the study.

When the preliminary interviews were analyzed, it was seen that pre-service teachers did not have sufficient knowledge about decision-making skills and 21st century skills. Considering the definitions of decision-making, it was determined that it is generally result-oriented and involves a process dependent on the subject being decided. However, when the steps of the decision-making process were examined, it became evident that pre-service teachers focused primarily on the final step, neglecting the other stages. Additionally, it was found that some pre-service teachers lacked sufficient knowledge about the steps involved in the process. To enhance their understanding of decision-making skills and processes, training was planned prior to the commencement of the research.

The findings indicate that pre-service teachers recognize decision-making as a skill that can be developed through training. Decision-making skill, which can be developed by practicing with a guide, is one of the complex and high-level skills (Çakmakçı & Özabacı, 2013). This shows that decision-making skills can be developed in a planned educational process. Doğanay (2011) asserts that the decision-making process is closely linked to skills such as research inquiry, critical thinking, problem-solving, and creative thinking. Consistent with these findings, the interdisciplinary nature of decision-making, a process often highlighted by pre-service teachers, was also emphasized.

Lunenburg (2010) defines the stages of the decision-making process as: defining the problem, creating and evaluating alternatives, selecting the most appropriate alternative, implementing the decision and evaluating the decision. In the preliminary interviews, pre-service teachers struggled to articulate the steps of the decision-making process. However, by the end of the process, they were able to fully describe the decision-making steps, aligning with Lunenburg's (2010) definition. In the study conducted by Bozkurt (2014), the change experienced by pre-service teachers regarding the decision-making process supports this result. The pre-service teachers especially emphasized the stages of defining the problem and choosing the most appropriate alternative. They included the determination of individual criteria for selecting the most appropriate alternative in their statements. The concept of multi-criteria decision-making in Xu and Yang's (2001) study has similarities with the step of establishing individual criteria in this study.

The characteristics of the decision-making individual can be generalized as being able to define the problem, analyze, have questioning skills, overcome the difficulties they face, produce, think critically and analytically, have responsibility, and have different perspectives (Kuzgun, 2000; Yıldırım-Kocakaya, 2017). This definition is similar to the characteristics expressed by pre-service teachers when defining the characteristics of a decision-making individual. While pre-service teachers viewed the decision-making individual as decisive, they also highlighted the ability to overcome challenges in the process, defining it as the capacity to reach a conclusion. In contrast to the characteristics identified in the preliminary interviews, the statements made in the final interviews reflect the traits of an individual with effective decision-making skills.

Decision-making is a crucial skill that individuals must apply in all aspects of life. It can be argued that decision-making skills are teachable and can be developed over time (Mettas, 2011). It

is important to include practices that are conducive to teaching, developing, and actively using this skill in learning environments. When the findings obtained were examined, especially discussion-based practices were prioritized. This is explained by the need for students to be active in the decision-making process. A review of the literature reveals that various methods and techniques are commonly used to develop decision-making skills. It was found that pre-service teachers often emphasized the importance of creating a discussion environment. Several studies support the notion that discussion-based practices can enhance decision-making skills (Goloğlu 2009; Gügük, 2019; Gülhan, 2012; Şengül, 2017; Tonus, 2012). Practices on socio-scientific issues (Demiral & Türkmenoğlu, 2018; Gülhan, 2012; İşeri-Kobal, 2022) and engineering design-based teaching (Ayaz, 2019; Ertuğrul, 2022) are supported by case studies. Additionally, a pre-service teacher (T3) noted that the activities implemented in learning environments may vary based on the class level. A review of different studies (Bozkurt, 2014; Karcılı, 2022; Kardaş, 2013; Yağcı, 2022) reveals that preferred grade levels (5th grade, 3rd-year undergraduate, 7th grade, and 1st-year undergraduate) differ, which supports this observation. Given that science education is fundamentally rooted in discussion, it can be concluded that discussion- and research-oriented practices have the potential to enhance decision-making skills.

The teacher plays a crucial role in the learning environment where development is to be achieved. Considering the findings obtained, pre-service teachers state that teachers who are expected to guide students in developing decision-making skills and have effective questioning skills will have a great impact on students' focus. The study conducted by O'Connor et al. (2011) highlights the negative impact of teachers' unfavorable attitudes towards students, which aligns with the views expressed by pre-service teachers. In this context, the absence of an authoritarian attitude in teachers enables students to freely express themselves.

Results and Discussion on the Training Process

Within the scope of this research, pre-service teachers were trained in decision-making skills. Based on the preliminary interviews, it was found that their level of knowledge of decision-making skills and processes was insufficient. The training content covered key topics such as decision-making skills, the decision-making process and its steps, decision-making styles, and the importance of decision-making in science education. To keep pre-service teachers actively engaged and provide them with hands-on experience, the training process was enriched with various applications that allowed them to experience the decision-making process firsthand. The pre-service teachers who engaged in the decision-making process through scenarios based on socio-scientific issues shared their experiences, which were followed by discussions. Additionally, various articles were read, and inferences were drawn. The pre-service teachers expressed positive views regarding the discussion-based environments and student-centered learning approaches. These findings are consistent with the results of the study conducted by Çolak (2022). A pre-service teacher (T5), who noted that this training process differed from those he had previously experienced, mentioned that engaging in the decision-making process was effective for his development. Küçükay (2018) defines decision-making as a conscious behavior performed with awareness. This suggests that a conscious experience cannot occur without understanding the definition, process, and steps involved in decision-making. The findings of the research align with this perspective.

It was determined that pre-service teachers experienced a change in the decision-making process. In addition, while the pre-service teachers indicated that this process enhanced their

individual awareness of their decision-making skills, they also believed that their decision-making abilities had improved. Demiraslan-Çevik (2013) similarly found that the lack of experience among pre-service teachers negatively affected their instructional decision-making levels, but as their experience grew, individual awareness developed, and their decision-making levels improved. These results support the findings of the present study. The pre-service teachers who reported progress in questioning their decisions and evaluating outcomes also mentioned that they had developed the ability to make future predictions. This aligns with Güçray's (1998) definition of decision-making as a cognitive process.

The pre-service teachers noted that the activities conducted during the process allowed them to experience the inquiry process and that the training contributed to the enhancement of their decision-making skills. This was particularly evident as they engaged in the stages of determining criteria for decision-making and evaluating these criteria. The key aspects highlighted in these statements were the scenarios involving socio-scientific issues and the discussion environments created. This suggests that the scientific discussion method focused on socio-scientific issues positively influences the development of decision-making skills within the educational process. Similarly, Sadler and Zeidler (2005) emphasized the necessity of making decisions on socio-scientific issues in order to understand complex scientific issues and develop decision-making skills in line with science literacy. The results revealed that reflecting on and making decisions about various socio-scientific issues helped the pre-service teachers develop multiple perspectives. Furthermore, the pre-service teachers expressed that the decision-making skills cultivated throughout the process fostered greater individual awareness.

There are knowledge and skills that pre-service teachers are expected to acquirePre-service teachers are expected to acquire knowledge and skills during their pre-service education. Pre-service teachersThey are expected to continue with the principle of self-improvement and use the skills they have gained during their teaching duty (Öztürk, 2001). The pre-service teachers reported experiencing difficulties due to the distinctive nature of the education process for decision-making skill training. They highlighted the challenges of making decisions regarding the socio-scientific issues addressed during the process. This finding is consistent with the study conducted by Parajes (1992). In his study, Pajares (1992) stated that pre-service teachers' past experiences, beliefs, and perceptions about the field will determine the teaching approach they will adopt in the future. The difficulty experienced by pre-service teachers during the process reflects the discomfort associated with change. Notably, one pre-service teacher mentioned that socio-scientific issues were too complex to have a meaningful say about. This observation aligns with the findings from the preliminary interviews, where pre-service teachers demonstrated an insufficient level of knowledge regarding 21st-century skills. The pre-service teachers had not yet mastered the competencies of a science-literate individual. However, this result is expected, as the study focused exclusively on developing decision-making skills.

The pre-service teachers found the decision-making training process both useful and necessary. They emphasized that all pre-service teachers, regardless of their field of study, should possess decision-making skills. Furthermore, they viewed the acquisition of this skill by pre-service teachers as a crucial step for enabling future generations to develop effective decision-making skills. Considering that the decision-making process can be acquired, especially in science courses, science teachers are the ones who realize this with the various learning environments they create. However, it is not possible for students to acquire a skill that they do not use and, therefore,

cannot develop (Jeffrey & Craft, 2004). This situation is similar to the findings obtained. A similar situation was observed in the study conducted by İpek-Akbulut and Kirman-Bilgin (2022). This study, conducted with pre-service science teachers, aimed to determine the professional knowledge of pre-service teachers regarding decision-making skills. The study concluded that the candidates do not have the necessary professional knowledge and equipment in the curriculum, and for this reason, necessary trainings should be provided to improve decision-making skills.

When examining the studies on the decision-making process in the literature, it is clear that they generally focus on measuring the decision-making skills of the sample group. As a result, most of the analyzed studies are quantitative or quantitatively weighted mixed-methods studies. However, there are few studies that explore the development of the decision-making process through planned training interventions. It is recommended that the educational process carried out to improve the decision-making skills of pre-service teachers be prepared for a longer period of time and be more comprehensive and that studies that can be applied should be planned. By developing various activities to enhance the decision-making steps of pre-service teachers, they can gain more experience in the decision-making process. A mixed-method approach could be preferred, with a larger sample size. This would allow quantitative and qualitative data to complement and support each other, providing a more comprehensive understanding of the process.

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Geniş Özet

Giriş

Karar verme, birey veya toplulukların, birden fazla seçenek arasından amaca ulaştıran alternatifin (Sakallı, 2019) ya da gerekli çözüm yolunun (Köse, 2002) seçilmesi olarak tanımlanır. Karakaya (1998), hiçbir eylemin karar vermeden gerçekleşemeyeceğini belirtmektedir. Karar verme becerisi fen öğretim programında yaşam becerileri başlığı altında yer almaktadır (MEB, 2018). Kazanımlar incelendiğinde ise karar verme becerisini işaret eden açık bir kazanım bulunmamaktadır. Program becerilerin önemine vurgu yapmakla beraber becerilerin öğretiminde kılavuz görevi görecek kazanımlara yer vermediği görülmektedir. Zoller (1987) karar verme becerisinin birey için önemini ve etkili bir öğretimle gelişebileceğini belirtmektedir. Öğretmen ve öğrencilerin karar verme becerisini fen konuları üzerinde etkili kullanabilmesi ve bu deneyimlerini günlük hayatlarına yansıtabilmeleri fen eğitimi açısından çok önemli ve gereklidir (Grace, 2009). Fen dersleri aracılığıyla karar verme becerisini geliştirmek hem dersin içeriğinin anlaşılması hem de becerinin süreç olarak gelişmesine yardımcı olacaktır (Covitt vd., 2013; Jho vd., 2013). Karar verme süreci fen eğitiminde büyük öneme sahiptir (Zeidler vd., 2005). Nitekim bu süreci yönetecek olan fen bilimleri öğretmenlerinin fen eğitiminin doğasını bilen ve çağın gerektirdiği yeterliklere sahip olması beklenmektedir (Akar, 2019). Özellikle de toplumun ihtiyaç duyduğu beceri ve nitelikleri öğrencilere kazandıracak olan öğretmen adaylarının aldığı eğitim önem taşımaktadır. Bu çalışmada, fen bilimleri öğretmen adaylarının, karar verme becerisi ve sürecine yönelik yeterliliklerinin belirlenmesi amaçlanmıştır. Bu bağlamda, karar verme becerisi ve sürecine yönelik tasarlanan eğitim programı, öğretmen adaylarının sosyobilimsel konular üzerine karar verme sürecini deneyimlemesine olanak tanımıştır. Karar verme becerisini geliştirmek amacıyla tasarlanan eğitim programının, süreç sonucunda öğretmen adaylarının karar verme yeterliliklerine yönelik yansımasını incelemek çalışmanın odağını oluşturmuştur.

Yöntem

Araştırma modeli karma yöntem desenlerinden iç içe (gömülü) desen olarak yürütülmesi gerektiği belirlenmiştir. Çalışmaya; 2022-2023 eğitim öğretim yılı güz döneminde Fen Bilimleri Öğretmenliği üçüncü sınıfta öğrenim gören, 9 kadın ve 4 erkek öğretmen adayı katılmıştır. Araştırma sürecinde öğrtmen adaylarına etkisi incelenecek olan eğitim planı araştırmacı tarafından hazırlanıp uzman görüşüne sunulmuştur. Uzmanların değerlendirmesinin ardından alınan dönütler doğrultusunda araştırmacı tarafından gerekli düzeltmeler yapılmıştır. Öğretmen adaylarının karar verme beceri düzeylerini belirlemek üzere Ercan ve Bozkurt'un (2013) ilköğretim öğrencileri için geliştirdikleri karar verme beceri testinin Bozkurt (2014) tarafından öğretmen adayları için uyarladığı Karar Verme Beceri Testi (KVBT) kullanılmıştır. Testin ortalama güçlüğünün 0.52 olduğunu tespit etmiştir. KVBT' nin uygulandığı örneklem grubu için KR 20 iç tutarlık katsayısını

0.71 olarak bulunmuştur. Bu çalışmada normal dağılım gözlenmediğinden, öğretmen adaylarına ait Karar Verme Beceri Testi ön-son test puanları arasındaki farkın anlamlı olup olmadığına bakmak için Wilcoxon İşaretli Sıralar Testi yapılmıştır. Çalışmada kullanılan yarı yapılandırılmış görüşmeler araştırmacı tarafından hazırlanarak uzman görüşüne sunulmuş ve gerekli görülen revizeler yapılmıştır. Bu araştırma sürecinde çalışmaya katılan öğretmen adayları ile ortalama ön görüşmeler ortalama 8 dakika ve son görüşmeler ortalama 40-45 dakikada gerçekleştirilmiştir. Araştırmanın nitel kısmını oluşturan bu görüşmeler, durum çalışmasına uygun olarak detaylı analiz edilmiş ve sonuçlar yorumlanmıştır. Araştırmanın güvenirliğinin arttırmak amacıyla, araştırmacı kodlama sürecini tamamladıktan sonra, bir uzman tarafından görüşme verileri incelenmiştir. Uzmanın verdiği revizeler doğrultusunda kodlar iki kez olmak üzere yeniden düzenlenmiş ve son halini almıştır.

Bulgular

Öğretmen adaylarının ön testte aldığı puanlar 1-6 aralığında değişirken son testte aldıkları puanların 6-8 puan aralığında değiştiği görülmektedir. Uygulama öncesi KVBT puan ortalaması 3.13 olan katılımcıların uygulama sonrası KVBT puan ortalaması 7.18 olmuştur. Ön görüşmede öğretmen adaylarının karar verme becerisi hakkında bilgi birikiminin ortaya çıkarılması amaçlanmıştır. 13 öğretmen adayından elde edilen nitel verilerin analizi sonucunda; "21. yüzyıl becerileri farkındalığı", "karar verme tanımları", "basamakları", "bireyin özellikleri", "geliştirilmesi" ve "karar verme beceri düzeyinin ölçülmesi" temaları altında kategorize edilen 45 kod elde edilmiştir. Temalar ayrıntılı olarak incelenerek öğretmen adaylarının karar verme becerisine yönelik bilgilerinin eksik olduğu belirlenmiştir. Süreç sonunda gerçekleştirilen son görüşmelerden elde edilen bulgular Karar Vermeye Yönelik Bulgular ve Eğitimin Değerlendirilmesine Yönelik Bulgular olmak üzere iki başlık altında incelenmiştir. "karar verme tanımları ", "basamakları", "karar veren bireyin özellikleri", "karar verme becerisini geliştiren öğrenme ortamları" ve "öğretmenin rolü" olmak üzere çeşitli temalar, temalardan ise 41 kod elde edilmiştir. Temalar incelendiğinde öğretmen adayları, ön görüşmelerin aksine karar verme becerisi ve sürecine yönelik bilgi ve deneyimlerinin geliştiği yönünde ifadelerde bulunmuşlardır. Eğitim sürecine yönelik elde edilen; "eğitime yönelik genel değerlendirmeler", "bireye katkıları", "etkinliklerin (senaryo-tartışma) faydaları" ve "eğitim sürecinde yaşanan zorluklar" temaları detaylıca incelendiğinde öğretmen adaylarının özellikle de tartışma ortamının ve karar verme sürecinin deneyimlendiği etkinliklerin, karar verme becerisini geliştirmede olumlu etkisine vurgu yapmışlardır.

Sonuç ve Tartışma

Wilcoxon işaretli sıralar testi sonuçlarına göre KVBT ön test ortalamaları ile son test ortalamaları arasında anlamlı bir fark görülmektedir. Bu fark son test ortalamalarının lehine (z=-3.186) olduğu için karar verme becerisi eğitim sürecinin öğretmen adaylarını karar verme beceri düzeylerine pozitif yönde katkı sağladığı görülmektedir. Bu araştırmanın sonucu ile yapılan diğer çalışmaların (Bozkurt, 2014; Sevgi, 2016) sonuçlarının benzerlik gösterdiği görülmektedir. Elde edilen bulgulara bakıldığında; öğretmen adayları karar vermenin beceri gerektirdiğine ve eğitim ile geliştirilebileceğine dikkat çekmektedir. Ön görüşmelerde karar verme süreç basamaklarını ifade etmekte zorlanan öğretmen adayları, sürecin sonunda karar verme basamaklarını eksiksiz ifade etmişlerdir. Bozkurt (2014)'un yapmış olduğu çalışmada öğretmen adaylarının karar verme sürecine yönelik yaşadığı değişim bu durumu desteklemektedir. Ön görüşmeler sonucunda oluşturulan bireyin özellikleri temasından farklı olarak, son görüşmelerdeki ifadeler karar verme

becerisine sahip bireyin özelliklerini yansıtmaktadır. Öğretmen adaylarının ifadelerinde karar verme becerisini geliştiren öğrenme ortamları arasından özellikle tartışma temelli uygulamalara öncelik verilmiştir. Literatürde tartışma temelli birçok uygulamanın karar verme becerisini geliştirdiğini destekleyen çalışmalar (Gologlu 2009; Gügük, 2019; Gülhan, 2012) mevcuttur. Ayrıca öğretmen adayları oluşturulan tartışma ortamları ve öğrenci merkezli gerçekleştirilen eğitime yönelik olumlu görüşler belirtmişlerdir. Elde edilen bu sonuçlar Çolak (2022)'ın yapmış olduğu çalışma sonuçları ile desteklenmektedir. Öğretmen adaylarının karar verme sürecinde değişim yaşadığı belirlenmiştir. Ayrıca bu sürecin sahip oldukları karar verme becerilerine yönelik bireysel farkındalık sağladığını belirtirken aynı zamanda karar verme becerilerinin geliştiğini belirtmektedirler. Bu durum Demiraslan-Çevik (2013)'in çalışması ile benzerlik göstermektedir. Öğretmen adayları, karar verme beceri düzeyinin artması üzerinde eğitimin etkisi olduğuna yönelik ifadelerde bulunmuşlardır. Ayrıca süreçte ele alınan sosyobilimsel konular hakkında karar vermenin zor olduğunu vurgulamışlardır. Parajes (1992)'in yaptığı çalışma ile benzer olarak; öğretmen adaylarının bilim okuryazarı bireyin yeterliklerine hakim olmadıkları belirlenmiştir. Fen bilimleri öğretmen adayları ile gerçekleştirilen bu çalışmada, öğretmen adaylarının karar verme becerisi üzerine mesleki bilgilerinin tespit edilmesi amaçlanmıştır. Çalışma; adayların öğretim programında yer alan gerekli mesleki bilgi ve donanıma sahip olmadığı, bu sebeple de karar verme becerisini geliştirmek adına gerekli eğitimlerin verilmesi sonucuna ulaşmıştır.