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Dejan Marolov

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Investigation of Career Decision Regrets Among Students in the Faculty of Sport Sciences: A Case Study of Bartın University

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Abstract

Education at the university level shapes one‘s professional career. A career in sports is more complex than in other professional fields. At times, individuals may experience career regret when faced with challenging situations, which can lead to negative emotions such as depression and loss of self-confidence. Therefore, this paper focuses on investigating the career decision regrets of students in the Faculty of Sports Sciences. The most common technique in descriptive research models, the survey method, was employed in the study. The study group consisted of 400 students from four different departments at Bartın University‘s Faculty of Sport Sciences. The researchers developed a personal information form, and the 'Career Decision Regret Scale' was utilized. Descriptive statistics, independent samples t-tests, and one-way ANOVA tests were applied to analyze the data. The results indicated that students in the Department of Sports Sciences at Bartın University experienced career decision regrets (mean = 38.05). The scale scores differed significantly based on students' age, department, year of study, place of birth, academic average, place of residence, part-time work, father's employment status, and educational level.

Keywords: Job, Decision, Remorse, Sport, Students

Introduction

A career is defined as the combination and sequence of roles played by a person throughout their lifetime. The root word carrus means a cart or chariot, from which the word via cararia (road) was derived, eventually leading to carriére and career (Super, 1980). Additionally, the Longman English Dictionary defines "career" as "a job or a profession for which one is trained and which one intends to follow for the whole of one's life" (Longman, 1989).

People have to make many choices in life. These choices may range from what clothes to wear or what to eat for lunch to more significant decisions such as choosing a profession, selecting a spouse, or deciding on a university department. Ultimately, individuals must choose one of the available options. They may be satisfied with their final decision or experience a sense of regret (Erdurcan & Kırdök, 2017). The decision points in a career reflect encounters with various personal and situational determinants (Super, 1980).

An individual will spend a significant part of their life in their chosen profession, often spending more time in the work environment than with family and friends. In this context, regretting a career decision can negatively affect both life and work. Career decision regret can lead to reduced job and life satisfaction, as it may cause an individual to perceive their living conditions negatively, ultimately affecting their overall well-being (Köse, 2014). Therefore, it is crucial to determine whether individuals regret their career choices.

Regret is the emotion that has received the most research attention from decision theorists. Most people can readily recall or imagine situations where a poor decision led to painful regret, with theories and vivid demonstrations exploring the antecedents and consequences of this emotion (Connolly & Zeelenberg, 2002). To examine regret in an individual's life, it is necessary to explore the past, relate it to the present, and consider its potential influence on the future (Hennessey, 2011). In the context of career decision-making, this means that cognitive (ability), affective (personality), and conative (motivation and interest) traits have traditionally been considered seperately rather than as integrated parts of the individual (Ackerman & Beier, 2003).

Regret is a frequently experienced emotion, evoked when a decision outcome compares unfavorably with the outcome that could have been achieved if a different choice had been made. This emotion typically arises when individuals perceive themselves as responsible for the outcome. The experience of regret focuses attention on one's role in the occurrence of the regretted outcome, motivating reflection on how the event could have been avoided and how similar situations can be prevented in the future (Zeelenberg, 1999). Self-exploration is a profoundly personal, reflective, and relational process (Hall & Chandler, 2005).

When a particular decision leads to an outcome that a person regrets or is unhappy with, they may ask themselves questions such as "What if I had not made that decision?" or "If only I had chosen differently." These thoughts are called counterfactuals because they counter what actually occurred (Bailey & Kinerson, 2005). The consequence of uncertain decision-making is termed decision regret (Bell, 1982). Brehaut et al. (2003) define regret as remorse or distress over a decision.

Some individuals may have insufficient self-knowledge when it is time to make a career choice. They may be undecided due to a lack of information about professions, feel pressured by significant others, or hold non-functional beliefs. Therefore, it is important to identify such students and help them address their indecision to raise a happy generation and efficient workforce (Çakır, 2004). University students are a dynamic group, comprising both young adults beginning their educational journey and mature students returning to university to redesign or change their career path. Regardless of age, students undergo a unique transitional period during university, characterized by overlapping educational, personal, and career-oriented issues, including decision-making, indecision, and career confusion (Pott, 2012). This study aimed to investigate undergraduate students' regrets regarding their career decisions.

Methods

In this study, the most common technique in descriptive research models, the survey method was employed. Convenience sampling was preferred, and the study group consisted of 400 students (149 females, 251 males) from four different departments at Bartın University, Faculty of Sport Sciences, during the 2021-2022 academic year. The researchers developed an individual information form, and the 'Career Decision Regret Scale' was used. Necessary permissions were obtained for the questionnaire used in the research. The questionnaire was prepared digitally using Google Form®. Participants were asked to complete it in face-to-face during the 2021-2022 fall and spring semesters via various applications such as WhatsApp and QR Code during lesson breaks. Students were informed about the study's purpose and the questionnaire.

The questionnaire designed to assess the career decision regrets of sports science students consists of two parts. The first part collected information including age, gender, grade level, place of birth, parents' education and profession, number of siblings, economic status, place of residence, involvement in sports, the person who directed them to sports, and whether they were employed. The second part of the questionnaire comprised the "Career Decision Regret Scale" developed by Brehaut et al. (2003). The original scale consists of 5 items in a single dimension. The Cronbach's Alpha internal consistency reliability coefficient of the scale, applied to various groups, was found to range between 0.81 and 0.92. In the validity study, there was a high correlation (r= -0.40 to -0.60) between the total score of the Decision Regret Scale and decision satisfaction, a positive correlation (r=0.31 to 0.52) for decision confusion, and a negative correlation (r=-0.25 to -0.27) for general quality of life. The original scale uses a 5-point Likert format, ranging from "1" (Totally Agree) to "5" (Totally Disagree), with items 2 and 4 reverse coded. To calculate the scores, one is subtracted from the value marked for each item. The resulting values are summed for each item, and a total score is obtained for all five items. This score is multiplied by five, yielding a value between 0 and 100 (Brehaut et al., 2003).

The Turkish adaptation, validity, and reliability process for the original scale was conducted by Erdurcan and Kırdök (2017). This adapted scale is considered a pioneer in measuring regret in career decision situations. Like the original, the Turkish version consists of five items in a single dimension using a 5-point Likert scale. To prevent misunderstandings and ensure objectivity in score calculation, the Turkish version was adjusted to range from 0 ("Do Not Agree") to 4 ("Totally Agree"). In the Turkish version, items 1, 3, and 5 are reverse coded. For scoring, the points of the reverse-coded items are adjusted, summed, and multiplied by 5, yielding a score between 0 and 100. A score of 0 and 24 indicates "no regret," 25-49 indicates "a little regret," 50-74 indicates "regret" and 75-100 indicates "very much regret" (Erdurcan & Kırdök, 2017). For data analysis, normality tests, descriptive statistics (frequency and percentage distributions), t-tests, and one-way analysis of variance (ANOVA) for independent groups were used. The significance level was set at $p < 0.05$. IBM® SPSS 21 software was used for the analysis.

Results

As a result of the analyses conducted to determine the career decision among students in the Faculty of Sport Sciences, it was found that the individuals experienced only a small degree of regret (Table 1).

Table 1. Participants' regret levels

Valid	400
Mean	38.05

The scale scores differed significantly based on students' age, department, grade level, place of birth, academic average, place of residence, part-time employment status, father's employment status, and education level. The ANOVA table for the participants' age variable is provided below.

Table 2. ANOVA results for the age variable and career decision regret

Age	N	Mean	sd	Source of Variation	Sum of Squares	df	Mean Square	F	p	Post Hoc (LSD)
1	67	43.73	29.71	Between Groups	7519.08	3	2506.36	4.21	.006*	1-2 3-2
2	213	34.08	21.20	Within Groups	235259.91	396	594.09			
3	104	41.39	25.84	Total	242779.00	399				
4	16	45.31	29.53							

*$p < 0.05$ **Group 1:** 17-19, **Group 2:** 20-22, **Group 3:** 23-25, **Group 4:** 25 and above

In Table 2, a significant difference was found between the age variable of participants and their career decision regret scores ($p < 0.05$). The LSD test revealed that the 17-19 and 23-25 age groups were significantly differed from the 20-22 age group. The ANOVA table for the department variable is provided below.

Table 3. ANOVA of the department variable and career decision regret

Departments	N	Mean	Sd	Source of Variation	Sum of Squares	df	Mean Square	F	p	Post Hoc (LSD)
1	100	33.90	17.84	Between Groups	26112.50	3	8704.167	15.90	.000*	2-1 2-3 2-4
2	100	52.00	30.77	Within Groups	216666.50	396	547.13			
3	100	33.95	18.64	Total	242779.00	399				
4	100	32.35	23.98							

*$p < 0.05$ **Group 1:** Physical Education Teaching, **G2:** Coaching Education, **G3:** Sports Management **G4:** Recreation

In Table 3, a significant difference was found between the department variable of the participants and their career decision regret scores ($p < 0.05$). The LSD test revealed that students in the Department of Coaching Education had higher career decision regret scores than the other groups. The ANOVA table for the grade level variable is provided below.

Table 4. ANOVA results for the grade level variable and career decision regret

Grade level	N	Mean	Sd	Source of Variation	Sum of Squares	df	Mean Square	F	p	Post Hoc (LSD)
1	120	29.38	18.94	Between Groups	13204.95	3	44.01	7.59	.000*	2-1 3-1 4-1
2	56	43.57	24.07	Within Groups	229574.04	396	579.73			
3	146	40.89	25.53	Total	242779.00	399				
4	78	42.12	28.01							

*$p < 0.05$ **Group 1:** 1st, **Group 2:** 2nd, **Group 3:** 3rd, **Group 4:** 4th and above

In Table 4, a significant difference was found between the grade level variable of the participants and the career decision regret scores ($p < 0.05$). The LSD test revealed that all grade levels, except the first-year group, had higher career decision regret scores. The ANOVA table for the place of birth variable is provided below.

Table 5. ANOVA results for the place of birth variable and career decision regret

Place of birth	N	Mean	Sd	Source of Variation	Sum of Squares	df	Mean Square	F	p	Post Hoc (LSD)
1	31	43.06	26.51	Between Groups	10252.137	3	3417.37	5.82	.001*	1-4 2-4 3-4
2	132	40.95	23.38	Within Groups	232526.86	396	587.189			
3	149	40.00	25.85	Total	242779.00	399				
4	88	28.64	21.69							

*$p < 0.05$ **Group 1:** Village, **Group 2:** Town, **Group 3:** City, **Group 4:** Metropole

In Table 5, a significant difference was found between the place of birth variable of the participants and the career decision regret scores ($p < 0.05$). The LSD test revealed that participants from village, town, and city backgrounds had higher career decision regret scores compared to those from the metropole area. The ANOVA table for the academic average variable is provided below.

Table 6. ANOVA results for the academic average variable and career decision regret

Academic average	N	Mean	Sd	Source of Variation	Sum of Squares	df	Mean Square	F	p	Post Hoc (LSD)
1	64	25.00	17.66	Between Groups	40122.34	3	13374.113	26.13	.000*	2-1, 2-3, 2-4, 3-1 3-4
2	65	56.08	28.26	Within Groups	202656.66	396	511.75			
3	188	40.35	22.18	Total	242779.00	399				
4	83	28.80	24.66							

*p < 0.05 **Group 1:** 0.0-0.99, **Group 2:** 1.0-1.99, **Group 3:** 2.0-2.99 **Group 4:** 3.0-4.0

In Table 6, a significant difference was found between the academic average of the participants and the career decision regret scores ($p < 0.05$). The LSD test revealed that the 1.0-1.99 academic average group had higher career decision regret scores than the other groups. Additionally, the 2.0-2.99 academic average group scored higher than the 0.0-0.99 and 3.0-4.0 academic average groups. The ANOVA table for the place of residence variable is provided below.

Table 7. ANOVA of the place of residence variable and career decision regret

Place of residence	N	Mean	sd	Source of Variation	Sum of Squares	df	Mean Square	F	p	Post Hoc (LSD)
1	41	42.20	21.96	Between Groups	16305.58	4	4076.39	7.110	.000*	1-3, 5-1, 5-3, 5-4
2	3	31.67	25.65	Within Groups	226473.41	395	573.35			
3	138	35.72	25.05	Total	242779.00	399				
4	155	33.61	20.97							
5	63	51.67	28.97							

*p < 0.05 **Group 1:** Family, **Group 2:** Relatives, **Group 3:** Friends, **Group 4:** Dormitory, **Group 5:** Others

In Table 7, a significant difference was found between the place of residence variable of the participants and the career decision regret scores ($p < 0.05$). The LSD test revealed that the group living with their family had significantly differed from the group living with friends. Additionally, the group living in other types of accommodation had significantly differed from the living with family, friends, or in dormitories. The t-test results for the part-time working variable are provided below.

Table 8. T-test results for the part-time working variable and career decision regret

Part-time working students	N	Mean	sd	T	P
Yes	152	47.53	27.28	5.92	.000*
No	248	32.24	20.93		

*P < 0.05

Table 8 shows a significant difference between part-time working students (mean = 27.28) and those not working (mean = 32.24). Part-time working students have more regrets about career decisions than non-working students. The t-test results for the father's working status variable are provided below.

Table 9. T-test results for the father's working status variable and career decision regret

Father's working status	N	Mean	sd	T	P
Yes	298	40.15	25.42	3.20	.002*
No	102	31.91	21.26		

*P < 0.05

Table 9 shows a significant difference between students whose fathers are employed (mean = 40.15) and those whose fathers are not employed (mean = 31.91). Students whose fathers are employed have more regrets about their career decisions than those whose fathers are not. The ANOVA table for the father's educational level variable is provided below.

Table 10. ANOVA results for the father's educational level and career decision regret

Father's educational level	N	Mean	sd	Source of Variation	Sum of Squares	df	Mean Square	f	p	Post Hoc (LSD)
1	30	30.67	24.59	Between Groups	99795.82	4	2494.95	4.23	.002*	3-1, 3-2, 4-1, 4-2
2	169	33.67	21.13	Within Groups	232779.18	395	589.36			
3	148	42.43	24.60	Total	242779.00	399				
4	51	44.51	31.61							
5	2	30.00	35.35							

*p < 0.05 **Group 1:** Not educated, **G2:** Primary, **G3:** High school, **G4:** Bachelor, **G5:** Master/PhD

Table 10 shows a significant difference between the father's educational level and the career decision regret scores (p < 0.05). As a result of the LSD test to identify which groups differed, it was determined that the high school graduate group had significantly differed from the not-educated and primary school graduate groups. Additionally, the bachelor graduate group scored significantly differed from the not-educated and primary graduate groups.

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Discussion

As a result of the analyses conducted to determine the career decision regrets of students in the Faculty of Sport Sciences, it was found that individuals had minimal regret (mean = 38.05). Köse (2019) reported similar findings of "little regret" in the study 'Teachers and Administrators Regret Due to Their Career Choice'. This result is expected for these students because they are closely engaged in at least one team or individual sport. Individuals involved in sports typically have a passion for it, leading to low levels of regret about career decisions. Students participate in sports with enthusiasm and dedication, which contributes to their success. Even if they have not yet achieved a prominent position, they believe they will in the future. These factors positively influence their career decisions.

The current study identified significant differences between career decision regrets and variables such as age, department, grade level, place of birth, academic average, place of residence, part-time work, father's employment status, and educational level. The scale scores were significantly differed by age variable. According to further statistic analysis, it was found that the 17-19 and 23-25 age groups' career decision regret scores significantly differed from the 20-22 age group. Sullivan et al. (2007) also found significant differences related to age, with regrets being more pronounced in the 35-44 and 55 and older age groups. Matarazzo et al. (2021) found that regret diminished with age. However, Demir (2023) found no significant difference in career decision regrets among physicians based on age, which contrasts with the current study.

A significant difference was found between career decision regrets and participants' departments, with students from the "Department of Coaching Education" exhibiting higher regret scores than those from other departments. Kılıç and Günal (2023) also found significant variation in career decision regret based on department, which aligns with the current study. Additionally, Çakır and Gönen (2022) found that students in the "Recreation Department" had significantly higher career decision regrets compared to students in other departments.

The study determined that all other grade levels had higher career decision regret scores compared to the freshmen group. Çakır and Gönen (2022) found a significant difference in career decision regret scores based on education level, particularly with higher regrets in higher grade levels, which aligns with the current findings. Conversely Doğanülkü and Güneşlice (2022) found no significant difference in proactive career behavior scores across class levels, which differs from the current study.

Significant differences were found based on place of birth, with village, town, and city groups having higher career decision regret scores than the metropole group. This might be due to a stronger desire for success and better career opportunities among those from less advantaged areas compared to those from metropole areas, who may feel more satisified with their career choices. Biricik-Gülseren (2019) supports this, noting that people with negative affect are more likely to experience career regret due to a tendency to disregard the possibility of achieving success.

According to the academic average variable, significant differences were found, with the 1.0-1.99 group having higher career decision regret scores than the other groups. Additionally, the 2.0-2.99 group was significantly differed from the 0.0-0.99 and 3.0-4.0 groups. Mora (2010) also associated regret with educational characteristics, such as final university grades, which is consistent with the current study.

In the current study, scale scores differed significantly based on the place of residence variable. It was found that career decision regret scores of students living with their families were significantly differed from the students living with friends. Additionally, students living in the 'other options' group was significantly differed from the students living with family, friends, or in dormitories. Living with family and in other types of accommodation might provide less confidence and drive students to seek more successful and prestigious careers, resulting in higher regret levels.

A significant difference was also observed between career decision regrets and part-time working status. Part-time working students expressed more regrets about their career decisions than those who were not working. Part-time work may intensify students' passion, leading them to experience greater regrets about their career choices.

Significant differences were found according to the father's employment status. Students whose fathers were employed had higher career decision regret scores compared to those whose fathers were not working. Observing their fathers' complex work conditions might lead students to desire better careers, resulting in higher levels of regret.

The scale scores also varied significantly based on the father's educational level. Students with fathers who had only a high school education had higher career decision regret scores compared to those whose fathers had no formal education or only completed primary school. Additionally, students whose fathers held a bachelor's degree had higher regret scores than those whose fathers had no formal education or only completed primary school. This may be due to the higher expectations that children of well-educated fathers might have. In reality, education does not always guarantee a promising career or suitable living conditions. Roese and Summerville (2005) found that the top six regrets in life, according to their meta-anlysis, include education, career, romance, parenting, the self, and leisure, which aligns with the findings of the current study.

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Conclusion

Career development, particularly the decision-making period, is complex for students in sports. In the current study, it was found that students studying in the Department of Sports Sciences at Bartın University had little regret about their career decisions (mean = 38.05). The scale scores of the students varied significantly according to their age, department, grade level, place of birth, academic average, place of residence, part-time working status, father's employment status, and educational level. At this point, faculties could involve students in sports-related associations. Additionally, career days could be organized by including various sport-related sectors. These initiatives would help students understand career opportunities and potentially alleviate their regrets about career decisions during their education. As a limitation, it should be noted that the study group consists of students from only one university. Future studies could benefit from increasing the number of participants by including students from the sports sciences faculties of different universities.

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The Nature of Science Assessment by Gifted Secondary School Students in Türkiye[1]

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Abstract

This research study aimed to assess the nature of science (NOS) understanding among students attending science and art centers in Türkiye. The study employed a case study design and a qualitative research method, focusing on 60 identified gifted middle school students at the Selçuklu Science and Art Center during the 2022-2023 academic year. The students' perspectives on the NOS were evaluated using the Nature of Science Evaluation Scale, and the collected data underwent descriptive analysis. The study's findings revealed that a majority of the gifted students demonstrated perspectives aligned with the NOS. However, many of these students' views regarding the role of scientists in shaping scientific knowledge did not align with the NOS. Additionally, the results indicated that students predominantly attributed the development of scientific knowledge to the observations made by scientists. These findings emphasize the significance of implementing targeted activities to enhance students' understanding of the NOS, potentially aligning their perspectives with the established principles of NOS.

Keywords: Gifted students, nature of science, qualitative research

Introduction

The contemporary global landscape of science and technology emphasizes the necessity for educational institutions to educate individuals who are attuned to these advancements. Educators have skillfully integrated the transformative shifts in educational paradigms into academic curricula. Currently, there is a notable focus on science literacy within the educational goals of numerous nations (American Association for the Advancement of

[1] This study is an extended version of the paper presented at the IXth Gifted Education Congress organized by Anadolu University on May 6-8, 2024.

Science [AAAS], 1990; Centurino & Kelly, 2021; National Research Council [NRC], 1996, 2011; National Science Teachers Association [NSTA], 2000; Ministry of National Education [MoNE], 2018; Roberts, 2007; The Organisation for Economic Co-operation and Development [OECD], 2013). Scientific literacy embodies various components, including content knowledge, the nature of science (NOS), and scientific inquiry (Shaakumeni, 2019). It necessitates not only comprehending scientific knowledge and its acquisition processes but also recognizing the complex interaction of science, technology and knowledge, and society. The application of these competencies to everyday decision-making processes is regarded as a crucial gauge of the effectiveness of education (OECD, 2013).

In his work, Polat (2018) underscores the importance of understanding NOS as a crucial element in achieving scientific literacy. Similarly, Timur et al. (2020) emphasize the need for a thorough understanding of NOS to promote scientific literacy among students. Conversely, Sexton (2023) highlights the great importance of the NOS concept in the field of science education. Therefore, it is vital to emphasize the relevance of NOS in the Turkish education system, as it significantly contributes to the improvement of scientific thinking skills and understanding for both students and educators. By emphasizing NOS within the Turkish education system, students can gain better insight into scientific processes and develop critical thinking abilities. In this context, the aim of this study is to reveal the evaluation of NOS of gifted middle school students attending Science and Art Centre (SACs) in Türkiye. The study initially proposes a conceptual framework relevant to NOS.

Nature of Science, Definition, and Principles

The field of science is characterized by a systematic and evidence-based approach that involves observation, experimentation, and logical reasoning in the pursuit of knowledge. As a continuously advancing domain, the primary goal of science is to explore the natural world and the universe through empirical evidence and reasoned explanations (Fawcett, 2019). Science is a dynamic discipline, wherein discoveries and the reevaluation or replacement of established theories with new evidence continually reshape the field (Ramachandran et al., 2021). The fundamental principles and attributes that define scientific knowledge and inquiry are deeply ingrained within the realm of science.

Common perspectives on the NOS can potentially lead to epistemic relativism as a consequence of misinterpretation (Romero-Maltrana et al., 2019). Therefore, it is crucial to clearly define the boundaries of this concept. Upon reviewing the literature on NOS, it becomes evident that while there are prevailing views on the definition of the NOS, there is a lack of precise limitation (Abd-El Khalick & Lederman, 2023). Godin and Gingras (2000) emphasize the significance of scientific literacy in understanding the NOS. Scientific literacy encompasses the understanding of scientific methodologies, the foundational principles of scientific inquiry, and the societal and ethical implications of scientific progress. Furthermore, McComas et al. (1998) argue that science is a multidisciplinary field that integrates various social sciences such as history, sociology, philosophy, and psychology, and intersects with cognitive sciences to formulate comprehensive definitions. According to Khishfe and Abd-El Khalick (2002), "It is not surprising that philosophers, historians of science, and sociologists alone cannot define the NOS because science is complex, dynamic, and multiple." In other words, the intersection of various disciplines such as philosophy, history, sociology, and psychology contributes to the understanding of the NOS, or the description of scientific endeavor. In this context, when examining the definitions of the NOS, one can deduce that the NOS encompasses the characteristics of scientific activities and scientific knowledge applied to explain natural phenomena. For instance, the scientific method directly relates to the stages of scientific processes, such as making observations, hypothesizing, and obtaining results, but the NOS influences these processes based on the scientist's understanding.

Using post-positivist methods, modern educational scientists who believe that teaching the NOS is an important component of scientific literacy for understanding how science works have established some foundational NOS principles (Lederman et al., 2002; McComas, 2014). Consequently, science educators have arrived at a level of consensus (Deng et al., 2012). For instance, according to Lederman et al. (2002), there are seven basic principles of NOS. These principles include (a) the empirical nature of scientific knowledge; (b) the relationship between scientific theories and laws; (c) the creative nature of scientific knowledge and imagination; (d) the theory-laden nature of scientific knowledge; (e) the relationship of scientific knowledge to the social and cultural environment; (f) the myth of the scientific method; and (g) the changeable nature of scientific knowledge.

The principle of the empirical nature of scientific knowledge, as emphasized by Lederman (1999), underscores the fact that scientific knowledge is, at least in part, derived from the observation of the natural world. Scientific knowledge advances based on data. Observations and experiments contribute to the development of scientific knowledge. However, scientists do not always have direct access to natural phenomena, leading them to rely on inferences. As a result, researchers in scientific studies do not adhere to a single method, nor do they follow individual steps. Consequently, students with sophisticated views on the empirical NOS should be capable of differentiating between observation and inference. This distinction enables students to better comprehend theoretical or inferential situations (Lederman et al., 2002).

The second principle of NOS involves students distinguishing between scientific theories and laws and understanding that they represent different types of knowledge. While laws offer explanations about the relationships between observable phenomena, theories provide inferred explanations for large sets of seemingly different observations in various fields of inquiry (Lederman et al., 2002). Experiments and observations contribute to scientific knowledge, and inferential interpretation of these data enlightens additional aspects of it.

According to the third principle of the NOS, creativity and imagination are also crucial for knowledge production in the creation of scientific theories and laws (Lederman et al., 2002). This principle asserts that the acquisition of scientific knowledge extends beyond mere observations and experiments. Every step of the research process demands the creativity and imagination of scientists, from designing the scientific study to collecting data and drawing inferences from it.

The fourth principle emphasizes the theory-laden nature of NOS knowledge. According to this principle, scientists' prior experiences, knowledge, and theoretical commitments influence their work. Therefore, their background beliefs and experiences can shape their observations and how they interpret them (Lederman et al., 2002; Okasha, 2002). In addition, the fifth principle underscores the social and cultural embeddedness of scientific knowledge. In reality, scientific knowledge is produced within a larger culture, and scientists develop within this cultural context. Therefore, science is not independent of culturally situated places and time but rather interacts with them. This principle generally states that various factors, such as social, political, and economic ones, both influence and are influenced by science (Allen & Baker, 2017; Lederman et al., 2002).

The sixth principle of NOS knowledge refers to the myth of the scientific method. There is a common misconception that all scientists adhere to a singular scientific method, leading to the development of infallible knowledge. However, there is no single method, such as the inductive method, that all scientists follow step by step. For instance, Galileo did not establish the laws of pendulum motion by systematically observing several pendulums and then making generalizations (Matthews, 2015). Instead, he employed the language of mathematics, believing that mathematics could effectively describe the behavior of objects in the material world. He also emphasized the experimental testing of hypotheses (Okasha, 2002).

Finally, Lederman et al. (2002) propose the last principle of NOS, which involves the transient nature of scientific knowledge. According to Lederman et al. (2002), scientific knowledge, including theories and laws, although reliable and durable, can change as new evidence becomes available.

For example, Newtonian physics has long been accepted by scientists as fundamental truth. However, in the early years of the 20th century, two revolutionary developments—the theory of relativity and quantum mechanics-demonstrated that Newtonian mechanics does not apply to all objects (Okasha, 2002).

The NOS in Gifted Education in Türkiye

According to Nouri and McComas (2021), there is a consensus among science educators regarding the significant role of the NOS in the school science curriculum. Understanding NOS has been highlighted by researchers as a crucial factor in fostering students' comprehension and appreciation of the scientific process, developing awareness of socio-scientific issues, internalizing the norms of the scientific community, acknowledging science as a fundamental component of contemporary society and culture, and achieving a deeper understanding of scientific content (Erduran et al., 2021). Furthermore, it is important to note the particular relevance of the NOS for gifted students.

The advanced reasoning abilities of gifted students naturally align with their innate interest in scientific knowledge, as noted by Nal and Büyük (2021). Moreover, the characteristics of gifted students are well-suited to the NOS, aiding in the development of their scientific thinking skills and comprehension of scientific knowledge. Renzulli (2012) also underscores the importance of the NOS in gifted education, as it equips students with the ability to engage with scientific knowledge critically and understand scientific thinking processes. Furthermore, Abu and Gökdere (2020) emphasize the significance of incorporating NOS in special education programs for gifted children, as it facilitates the optimal development of their exceptional talents.

Examining how and to what extent Türkiye's elementary science curricula (MoNE, 2018) reflect the NOS reveals that the curriculum incorporates science literacy into its specific objectives and domain-specific skills. However, one of the necessary dimensions for raising science-literate individuals is knowledge about the NOS (Lederman & Druger, 1985; Lederman, 1992, 1999, 2010; Lederman et al., 2002; Shamos, 1985). It is also important that students comprehend the basic skills in the curriculum and transfer them to their daily lives. In this context, SACs in Türkiye play a crucial role in assisting gifted students in comprehending the NOS and implementing this knowledge in their everyday lives.

SACs are important institutions in Türkiye that provide education to gifted students outside of formal education and serve to help gifted students realize their potential. Given their unique characteristics, gifted students require a tailored education program and an educational environment that aligns with their needs (MEB, 2022, p.11). The activities to be implemented

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should include components such as higher-order thinking skills, open-ended and creative thinking, discovery, reasoning, research, group interaction, and freedom of choice in the process dimension. Additionally, to differentiate the product dimension, components such as problem awareness, working with real-life problems, real target audience, evaluation, creativity, and diversity in the product should be considered. In other words, this encompasses the application of science process skills structured in the science education provided in formal education institutions.

Examining the literature on the NOS reveals that students' perspectives on NOS are quite limited and lack accurate information (Abd-El-Khalick & Lederman, 2000; Lederman, 2007; Mellado, 1998; Moss, 2001; Rahayu, 2020; Yacoubian, 2021). In Türkiye, there is no study investigating gifted students' perceptions of the NOS in SACs. In the context of this study, it is essential to elucidate the perceptions of students enrolled in SACs regarding their assessment of NOS.

According to Akarsu (2017), students' cultural characteristics can significantly influence their perspectives on the NOS. This finding suggests that the NOS evaluations of gifted students from different cultural backgrounds should be further investigated. Furthermore, the outcomes of such research could offer valuable insights for curriculum developers and educational material authors. Consequently, this study seeks to investigate the assessment of NOS among students attending SACs.

Method

This research was conducted using a case study design. According to Ekiz (2003), case studies necessitate a detailed examination to describe and interpret all points related to a particular situation. This study includes a comprehensive research to reveal gifted students' assessment of NOS.

Study Group

We conducted research involving 60 gifted middle school students who are enrolled at the Selçuklu Science and Art Center in Türkiye for the 2022–2023 academic year. The study utilized the homogeneous sampling method to select its participants, as described by Baltacı (2018). This method involves selecting a sample that corresponds to a particular subgroup in the population relevant to the research problem. Incorporating gifted students as participants in this study was considered beneficial when employing this sampling technique. Table 1 provides demographic information about the participants comprising the study's sample.

Table 1. Demographic Information of Participants

Variable		n	%
	5th grade	18	30
Class level	6th grade	15	25
	7th grade	10	17
	8th grade	17	28
Gender	Female	30	50
	Male	30	50
	Imam hatip middle school	5	8
School type	Middle school	25	42
	Private middle school	30	50,00

According to Table 1, 18 of the gifted students were in the 5th grade, 15 in the 6th grade, 10 in the 7th grade, and 17 in the 8th grade. Notably, 30 of the students are female, and 30 are male. Additionally, 30 of the gifted students were enrolled in private secondary schools, 25 in public middle schools, and 5 in Imam Hatip middle schools.

Data Collection Tool

In qualitative research, closed-ended questions effectively gather specific information from participants (Sezer & Güven, 2022). Although qualitative research generally aims to explore in-depth meanings and understand the richness of data, closed-ended questions can still provide valuable insights when used appropriately. Particularly, semi-closed-ended questions that reveal participants' perspectives can yield abundant data for qualitative research.

In the study, the "Nature of Science Assessment Scale" developed by Muşlu (2008) was used to reveal gifted students' evaluation of the NOS. This scale consists of 15 questions and allows the participants to express their different opinions about the given options (Appendix 1). Questions 1 and 2 pertain to Science; questions 3, 4, 5, 6, 7, 8, and 15 are related to the Structure of Scientific Knowledge, while questions 9,10, 11, 12, 13 and 14 are about the Scientific Method. We also asked the participants about their grades, genders, and school types to gather their demographic information.

Data Collection and Analysis

We initiated the research by informing parents of its purpose and obtaining their permission through a distributed consent form. The form explicitly outlined that data would not be shared with third parties, no private information would be requested, and participants could withdraw at any time. We collected student data using a physical assessment, ensuring voluntary participation. Prior to the assessment, we informed participants about the study and addressed their questions. The assessment, conducted across different grade levels, lasted about 20 minutes.

Qualitative research focuses on examining the depth and richness of data, while the use of frequency tables can help researchers identify patterns, trends, and the distribution of specific characteristics across cases (Cloutier & Ravasi, 2020). Moreover, researchers can use frequency tables to quantitatively represent qualitative data, providing a structured format for analysis and interpretation. This method has been utilized in studies conducted by various researchers (Bango, 2023; Bekiroğlu & Güllühan, 2023) to uncover the NOS evaluations of gifted students. Researchers used frequency tables to reveal the NOS evaluations of gifted students in this study context.

In our study, we conducted a descriptive analysis of the collected data. First, we created a frequency table to show the distribution of the participant's responses to the scale questions among the different options and documented it in Appendix 2. Then, we categorized the opinions of the gifted students who selected the other option in the scale items. In this process, since we saw that some student opinions were different forms of the answers given in the options, we evaluated them within the existing options. Also, we grouped student opinions that didn't fit into a specific category under the other option. In addition, we used direct quotations to present the opinions of the students who chose the other option in the research. To ensure the validity and reliability of our findings, we considered it a crucial condition for our team to maintain consensus throughout the process. In addition, to increase the validity and reliability of the research, the opinions of an auditor who is an expert in this field were utilized.

Findings

In this section, the findings obtained as a result of the research are given.

Findings Related to the Perceptions of Gifted Students Regarding Science

The discussion focused on the answers to questions 1 and 2. First, we analyzed the gifted students' responses to the question "Why do scientists do science?" in the context of the title. Table 2 presents the opinions expressed on this subject.

Table 2. Gifted Students' Perceptions of the Reasons Why Scientists Do Science

1. Why do scientists do science?

Answers	n
A. For information	8
B. To find the unknown	14
C. To acquire knowledge for the benefit of humanity	27
D. To understand nature	4
E. For financial gain	6
F. To fulfill a need	2
G. To improve the quality of life	2
Other	1

Table 2 analysis reveals that gifted students primarily pursue science to gain knowledge for the betterment of humanity (n = 27). Finding the unknown (n = 14), acquiring knowledge (n = 8), and making financial gains (n = 6) are the next steps. Some of the opinions of the gifted students who selected the Other option (those who selected choices other than A, B, C, and D) are as follows:

- *Scientists use science to improve life quality and fulfill a need* (S26).
- *Scientists use science to discover what they are curious about* (S27).
- *Scientists do science to make money* (S45).
- *Scientists use science to understand the events in the universe* (S54).
- *Scientists do science to learn the secrets of science and to be useful to humanity (S60).*

We asked the second question, "What is science?". Table 3 presents the obtained answers.

Table 3. Gifted Students' Perceptions of the Science Concept

2. What is science

Answers	n
A. To find the unknown	22
B. To understand nature and human beings	21
C. To obtain evidence	7
D. Data obtained as a result of research	2
E. It is a process of discovery.	3
F. Unlocking the universe's secrets	3
Other	2

Table 3 reveals that gifted students primarily define science as exploring the unknown (n = 22), comprehending nature and humans (n = 21), and gathering evidence (n = 7). The opinions of some of the gifted students who chose the Other option (those who chose options other than A, B, C) are as follows:

- *The term "science" refers to data obtained through research* (S2).
- *People benefit from discoveries and inventions* (S15).
- *Science investigates how everything in the universe works* (S19).
- *Science involves developing technology and solving the universe's secrets* (S51).
- *Science is about exploring nature, the world, and finding innovations* (S57).

Findings Related to the Perceptions of Gifted Students on the Structure of Scientific Knowledge

We first determined whether the thoughts of the scientist who discovered it affected the perceptions of gifted students about the structure of scientific knowledge or not**.** Table 4 presents this situation.

Table 4. Gifted Students' Perceptions of Whether the Thoughts of the Scientist Who FoundIt Influence Scientific Knowledge or not

3. Scientific knowledge is the discovery of the scientist;	
Answers	n
A. Personal thoughts do not have an impact.	34
B. One's thoughts have an impact.	23
Other	3

Analyzing Table 4, we found that 34 of the gifted students believed the personal thoughts of the scientist who discovered it would not affect scientific knowledge, whereas 23 of the students believed the personal thoughts of the scientist would influence scientific knowledge. In this context, the opinions of the students in the Other option are as follows:

- *The thoughts of the scientist who discovered something cansometimes influence or not affect scientific knowledge* (S6).
- *A person's interests and curiosity influence scientific knowledge. However, we cannot fully measure this* (S11).
- *The person's knowledge either influences or does not affect the value of the scientist's knowledge and equipment* (S51).

Whether scientific knowledge would change over time or not was the second issue relating to gifted students' perceptions about the structure of science. Table 5 presents the opinions of gifted students within this scope.

Table 5. Perceptions of Gifted Students Regarding Whether Scientific Knowledge Will Change or not

4. Scientific knowledge found by scientists;

Answers	n
A. May change over time	52
B. Absolutely unchanged	4
Other	4

Analysis of Table 5 revealed that the majority of gifted students (n = 52) believed that scientific knowledge could evolve. In this context, it is noteworthy that four students think that scientific knowledge will never change. Additionally, we discussed the opinions of four students under the title "Other." These opinions are as follows:□

- *It may change over time, but it remains the same as a pattern* (S11).
- *Depending on the situation, scientists' findings may or may not change* (S39)
- *Scientists find that scientific knowledge sometimes changes and sometimes does not change. It depends on knowledge* (S50).

The third question pertained to the perceptions of gifted students regarding the structure of scientific knowledge, specifically whether the number of scientists working on it would influence its structure or not. Table 6 presents the opinions of gifted students in this context.

Table 6. Gifted Students' Perceptions of Whether Scientific Knowledge Will Change Depending on the Number of Scientists Working on It or not

5. Scientific knowledge;

Answers	n
A. The more people working on it, the faster it may change.	40
B. The number of people working on it does not matter.	14
C. Because it is unchangeable, the number of people working on it has no impact.	4
Other	2

According to Table 6, the majority of gifted students think that scientific knowledge can change more quickly as more people work on it. However, it's noteworthy that 14 of the students expressed the belief that the number of people working on scientific knowledge would not affect its evolution. On the other hand, it's significant for the reliability of the findings that four students, who had previously stated that scientific knowledge would never change, now agreed with this statement. In this context, the gifted students who expressed their opinions in the Other option provided the following statements:

- *Scientific knowledge can change independently of the number ofpeople working on it* (S18).
- *It depends on whether the people working on it change scientific knowledge or not* (S50).

The fourth issue pertains to gifted students' perceptions of the structure of scientific knowledge, specifically focusing on its foundation. Table 7 provides the opinions of gifted students in this context.

Table 7. Perceptions of Gifted Students on the Basis of Scientific Knowledge

6. Scientific knowledge ;

Answers	n
A. It emerges as a result of scientific observations.	38
B. The information is based on the knowledge of scientists.	1
C. Using the reasoning of scientific experts	5
D. It is based on scientific experience and logic.	10
Other	6

Analysis of Table 7 reveals that gifted students primarily believe that scientists' observations lead to the emergence of scientific knowledge (n = 38). In addition, it is noteworthy that 10 of the students stated that scientific knowledge is based on the experiences and logic of scientists, while 5 of the students think that scientific knowledge emerges only based on the logic of scientists. In this context, some of the gifted students who chose the Other option have the following opinions:

- *It is based on scientists' observations, experiences, and curiosity* (S2).
- *It is based on scientists' observations and logic* (S9).
- *It is based on scientists' observations and reasoning* (S16).

The fifth point pertains to the perceptions of gifted students regarding the structure of scientific knowledge and the methods scientists employ to create it. Table 8 provides the opinions of gifted students in this context.

Table 8. Gifted Students' Perceptions of the Principles Scientists Follow in Creating ScientificKnowledge

7. Scientists create scientific knowledge;

Answers	n
A. First conducts research, observation, and experimentation, and thenhypothesizes.	6
B. Conducts research by making predictions and then making inferences.	12
C. Observation comes first, followed by research, experimentation, and hypothesis.	3
D. Observation, research, prediction, hypotheses, and experiments come first.	30
Other	9

Analysis of Table 8 reveals that more gifted students (n = 30) believe that observation, research, prediction, hypothesis, and experiment stages lead to the emergence of scientific knowledge. Those (n = 12) who believe that the stages of prediction, research, and inference form scientific knowledge come next. In this context, it is also noteworthy that gifted students preferred the answers (A = 6, C = 3) for the final establishment of the hypothesis. In this context, some of the students who preferred the other option expressed the following:

- *Ask questions, conduct research, formulate hypotheses, conduct experiments, and prepare reports and presentations* (S1).
- *The individual finds problems, makes observations, hypothesizes, conducts research, and conducts experiments* (S3).
- *Ask questions, conduct research, formulate hypotheses, conduct experiments, and prepare reports and presentations* (S26).
- *The researcher finds a problem, makes observations, hypothesizes, and conducts research and experiments* (S38).
- *The researcher identifies the problem, investigates, hypothesizes, and conducts experiments* (S60).

Sixthly, the effect of dreams on the perceptions of gifted students about the structure of scientific knowledge was discussed in the process of scientists creating scientific knowledge. Table 9 presents the opinions of gifted students on this subject.

Table 9. Perceptions of Gifted Students on the Effect of Imagination on Scientists' Creation of Scientific Knowledge

8. Scientists create scientific knowledge;

Answers	n
A. Their imagination is effective.	6
B. Because it has no place in science, imagination has no effect.	7
C. Their imagination and creativity are effective.	40
D. Their imagination and creativity are ineffective.	4
Other	3

Upon conducting an in-depth analysis of Table 9, it can be inferred that a substantial majority of the gifted students, comprising a sample size of 40, perceive imagination and creativity as vital components in the generationof scientific knowledge by scientists. It is also noteworthy that six of the students exclusively attributed scientific knowledge creation to imagination. In contrast, the responses of seven students who deemed their imagination to be ineffective and four of the students who believed that their imagination and creativity were both ineffective carry significant weight. Moreover, the gifted students who opted for the 'other' category expressed their views as follows:

- *Scientists' imagination, knowledge, creativity, determination and curiosity are effective* (S1).
- *Scientists' imagination, knowledge, creativity, determination and curiosity are effective* (S26).
- *Imagination is effective in some knowledge, but not in others* (S60).

Finally, we investigated gifted students' perceptions of the structure of scientific knowledge in terms of who benefits from it. Table 10 presents gifted students' perspectives on this subject.

Table 10. Perceptions of Gifted Students on Who Scientific Knowledge Is for

15. Scientific knowledge ;

Answers	n
A. For the people	2
B. Only for scientists	2
C. For both scientists and the public	56

Analysis of Table 10 reveals that the majority of gifted students (n = 56) believe that scientific knowledge is for both scientists and the public. In addition, some students think that scientific knowledge is only for the public (n = 2) and for scientists (n = 2).

Findings Related to the Perceptions of Gifted Students Regarding the Scientific Method

We first discussed the prerequisites for accepting scientific knowledge, as well as gifted students' perceptions of the scientific method. Table 11 presents gifted students' perspectives on this subject.

Table 11. Gifted Students' Perceptions of the Prerequisites for Scientific Knowledge Acceptance

9. For the acceptance of scientific knowledge;

Answers	n
A. Observational data must prove it.	10
B. Must incorporate experimentation and observation.	23
C. Does not necessarily involve experimentation andobservation.	1
D. Experimental data must validate the claim.	24
Other	2

Analysis of Table 11 reveals that gifted students advocate for the acceptance of scientific knowledge based on experimental data (n = 24), experiment and observation (n = 23), and observation data (n = 10). However, one student noted that acceptance of scientific knowledge does notnecessarily require experimentation and observation. Those who chose the "Other" option on this issue put forward the following:

- *If possible, it should include observation and experiment data. If not possible, it should be based on observation and logic* (S16).
- *We need to prove it in every way* (S20).

The second issue, which pertained to gifted students' perceptions of the scientific method, concerned the motivations behind scientists' experiments. Table 12 presents the perspectives of gifted students on this subject.

Table 12. Perceptions of Gifted Students on the Reasons Behind Scientists' Experiments

10. Scientists carry out experiments because;

Answers	n
A. They want to make new inventions.	4
B. They want to test their ideas.	15
C. They want to prove their ideas.	16
D. They want to find something to help people.	19
Other	6

Table 12 reveals that gifted students believe scientists conduct experiments to find solutions for people (n = 19), validate their ideas (n = 16), and test their ideas (n = 15). In addition, some gifted students think that scientists conduct experiments to make discoveries (n = 4). Those who chose the other option and expressed their opinions on the issue stated the following:

- *They want to meet their needs and improve their quality of life* (S1).
- *They want to be pioneers in development* (S10).
- *They want to earn money* S48).

The third issue, which pertains to gifted students' perceptions of the scientific method, concerns scientists' knowledge and prediction of results before experimentation. Table 13 presents the opinions of gifted students on this subject.

Table 13. Gifted Students' Perceptions of Scientists' Knowing and Predicting the Results Before Doing the Experiment

11. Before scientists conduct experiments;

Answers	n
A. Understand their experiments' results.	0
B. They do not know the results of their experiments.	9
C. Forecast the results of their trials.	47
D. They do not predict the outcome of their experiments.	3
Other	1

Analysis of Table 13 reveals that the majority of gifted students (n = 47) believe scientists predict experiment results. Furthermore, gifted students expressed that scientists do not know the results of experiments (n = 9) and do not predict the results (n = 3). In this regard, one student who chose the other

option stated the following:
All of these can happen. It depends on the research type (T22).

The fourth question, which pertained to gifted students' perceptions of the scientific method, inquired whether the opinions of scientists influenced the experiment results. Table 14 presents the opinions of gifted students on this subject.

Table 14. Gifted Students' Perceptions of Whether Scientists' Ideas Influence the Results of Experiments

12. Experiment results from scientists' opinions;	
Answers	n
A. Influenced	28
B. Not influenced	28
Other	4

Examining Table 14, it becomes clear that gifted students disagree on whether scientific ideas influence experiment results. In this regard, 28 of the students believed that the ideas of scientists influenced the experiment results, whereas another 28 of the students held the opposite opinion. In addition, four students chose the Other option and expressed their opinionson this issue. We can list some of these opinions below:

- *It may differ depending on the scientist's attitude (S4).*
- *Sometimes it is affected, and sometimes it is not (S20).*
- *Sometimes it is affected, and sometimes it is not (S50).*

Fifthly, we examined the reasons for the shift in gifted students' perceptions of the scientific method. Table 15 presents the opinions of gifted students on this subject.

Table 15. Gifted Students' Perceptions of the Reasons Behind the Change of Some Theories

13. Some theories in science can change because	
Answers	n
A. We now have more advanced technology.	24
B. Scientists can make mistakes.	12
C. Scientists are now applying different methods.	10
D. We can obtain additional evidence.	10
Other	4

An analysis of Table 15 reveals that gifted students primarily attribute changes in science theories to the use of more advanced technology (n = 24). Additionally, some students expressed the belief that scientists can make mistakes (n = 12), apply different methods (n = 10), and obtain more evidence (n = 10). Below is a list of some of the opinions expressed by those who selected the other option:

- *Technology has developed, and scientists can also make mistakes* (S1).
- *Theories can become obsolete over time* (S7).
- *Theories can't be changed (S*43).

Finally, we examined gifted students' perceptions of the scientific method and how they would behave if scientists had to choose between two theories. Table 16 presents the views of gifted students on this subject.

Table 16. Perceptions of Gifted Students on How Scientists Would Behaving If They Had to Choose One of Two Theories

14. When scientists have to choose between two theories,	
Answers	n
A. They choose what is closer to the truth.	29
B. They choose what is more useful in daily life.	13
C. They select the option that receives the most acceptance from scientists.	7
D. They choose the one with more advanced technology.	4
Other	7

Upon analyzing Table 16, we find that the majority of gifted students (n = 29) expressed their preference for the theory that is closer to the truth. This is followed by students who stated that they would choose the one that is more useful in daily life (n = 13), the one accepted by more scientists (n = 7), and the one that involves more advanced technology (n = 4). The opinions of some of the gifted students who preferred the Other option are as follows:

- *They choose what they have reached as a result of their experiments and observations* (S26).
- *They do not select both. They do research again* (S44).
- *They should choose the safest one* (S45).

Discussion

When analyzing the perceptions of gifted students about science, it was determined that the majority of the students believe that scientists engage in scientific pursuits to acquire knowledge for the benefit of humanity and to explore the unknown. Additionally, it was found that gifted students define science as the quest to explore the unknown and to comprehend nature and human beings. These findings indicate that gifted students possess a realistic view of the NOS. Also, these findings align with the results of the study conducted by Muşlu (2008). Nevertheless, the perspective that scientists engage in scientific endeavors solely for financial gain is not deemed valid in the context of the NOS.

Upon discussing whether the thoughts of the scientists who discovered scientific knowledge influence it within the context of the research and gifted students' perceptions about its structure, it was found that the majority of gifted students believe that the thoughts of the scientists who discovered it do not influence scientific knowledge. However, a significant number of gifted students hold the opposing view. In the literature, studies conducted by Lederman (1992) and Bell and Lederman (2003) demonstrated that the thoughts of the scientist who discovered something can influence scientific knowledge. In this regard, Ryan and Aikenhead (1992) stated that certain characteristics of scientists (gender, age, education, experience, beliefs, disciplines they are affiliated with, etc.) have an impact on their studies. Therefore, the majority of gifted students lack a perspective that aligns with the NOS.

Second, we examined whether scientific knowledge can change over time within the scope of gifted students' perceptions of the structure of scientific knowledge. This examination determined that the majority of gifted students held the opinion that scientific knowledge can change over time. According to Popper (1963), who stated that scientific knowledge is reliable and valid for a long time, this situation is not completely true or certain. All kinds of laws, theories, and hypotheses accepted as scientific are open to change (Çelik, 2009; Renn, 2020). However, a study by Woitkowski et al. (2021) focused on undergraduate students in Germany and revealed that these students had a limited understanding of the diversity within scientific knowledge. This finding highlights the significance of gifted students' perspectives being aligned with the expected level on this matter.

Thirdly, the study examined how gifted students perceive the structure of scientific knowledge and whether the number of scientists working on it can influence its evolution. The research revealed that the majority of gifted students (n = 41) believed that the more people work on scientific knowledge, the faster it can change. We can accept this finding as acorrect view, given the NOS. This finding aligns with the findings of Muşlu's (2008) study.

The fourth issue pertains to gifted students' perceptions of the structure and basis of scientific knowledge. The research reveals that gifted students primarily believe that scientists' observations lead to the emergence of scientific knowledge (n = 38). Examining the assumptions about the NOS emphasizes the importance of observation in thedevelopment of scientific knowledge, but also highlights the effectiveness of creativity and imagination in this process (Bell, 2009; Lederman, 2010). In this context, it is considered necessary for the scientist to use inference skills as well as observation in the production process of scientific knowledge (Abd-El-Khalick et al., 2001). These explanations lead to the conclusion that most gifted students approach scientific knowledge from an empirical perspective. This finding was also revealed in a study conducted by Marin et al. (2018). The study found that middle school students believe scientific knowledge is produced through observation and experimentation.

Fifthly, the research addressed gifted students' perceptions about the structure of scientific knowledge and how scientists create it. The research reveals that more gifted students (n = 30) believe that observation, research, prediction, hypothesis, and experiment stages lead to the emergence of scientific knowledge. Furthermore, it is noteworthy that some students assert that different methods contribute to the formation of scientific knowledge. In this regard, Abd-El-Khalick et al. (2001) state that there are various ways that scientists use the process of producing scientific knowledge. Due to this situation, scientists do not have an obligation to carry out scientific activities by following a certain order (Muğaloğlu, 2006). In this context, students' gathering around different views can be considered as a situation that should exist in terms of the NOS.

Sixth, we examined how imagination affects gifted students' perceptions of the structure of scientific knowledge. The study revealed that most gifted students (n = 40) believed that scientists used imagination and creativity effectively to create scientific knowledge. This finding is in line with the results of the studies conducted by Çetinkaya (2019), Liu and Liberman (2002) and Muşlu (2008). On the other hand, this finding is consistent with the NOS’s assumptions. To address this issue, Irez and Turgut (2008) state thatscientists use imagination and creativity in their studies.

Finally, we analyzed gifted students' perceptions of the structure of scientific knowledge in terms of who should benefit from it. The study revealed that most gifted students (n = 56) believed that scientific knowledge should benefit both scientists and the public. This finding aligns with the findings of Muşlu's (2008) study.

The objective of the current research was to investigate the conditions necessary for gifted students to embrace scientific knowledge related to their understanding of the scientific method. The study revealed that gifted students demonstrated a strong preference for experimental data (n = 24) as ameans of supporting scientific knowledge. Additionally, the majority of participants (n = 23) highlighted the importance of including experimentation and observation as an intrinsic component of scientific inquiry. Furthermore, a smaller group of participants (n = 10) believed that observational data played a critical role in validating scientific knowledge. These findings suggest that gifted students place significant importance on the integration of experimentation and observation methods in the pursuit of scientific inquiry. This result can be considered realistic in terms of science's nature. Popper (1979) stated that scientific knowledge should be verifiable orfalsifiable and revealed the NOS's approach to this issue. According to the literature, experiments and observations have an important place in the production of scientific knowledge (Erçetin & Görgülü, 2018). Alexander et al. (2012) emphasize the significance of experiments and observations in learning about

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and becoming interested in science.

Second, the discussion focused on gifted students' perceptions of the scientific method and the motivations behind scientists' experiments. The research revealed that gifted students attribute scientists' experiments to their desire to find solutions, validate their theories, and test their hypotheses. This discovery reveals scientists' motivational sources. Therefore, we can assert that "scientists who conduct experiments find motivation in helping people and in testing and proving their ideas." Venville et al. (2013) also advanced this assumption in their research. This research identified scientists' passion for knowledge and science and revealed that these are the most important sources of motivation.

Thirdly, we analyzed gifted students' perceptions of the scientific method, specifically their belief that scientists know and predict experiment results before conducting them. The study revealed that most gifted students believed scientists predict experiment results. Solomon et al. (1996) conducted a study that yielded similar results. In this study, more than half of the participants claimed that scientists make predictions about the results of experiments.

The fourth question, which pertained to gifted students' perceptions of the scientific method, inquired whether the ideas of scientists influenced the experiment results or not. The research revealed that gifted students held varying opinions regarding the influence of scientists' ideas on experiment results. In this regard, 28 of the students believed that the ideas of scientists influenced the results of experiments, whereas 28 of the students held the opposite opinion. Examining this situation through the lens of science reveals that scientists' approaches shape scientific knowledge. In particular, the creativity and imagination of scientists are considered important factors here (Lederman et al., 2002). Scientists direct their work with creativity and imagination in all processes of scientific knowledge production (Akerson & Donnelly, 2010). In this context, we can consider the view that scientists' ideas influence scientific knowledge as a more accurate approach to understanding the NOS.

In the study, the reasons behind the change of some theories were examined as the fifth reason related to the perceptions of gifted students about the scientific method. The research revealed that gifted students primarily attributed the change in some scientific theories to the availability of more advanced technology. In addition, some students stated that scientists can make mistakes, that researchers now apply different methods, and that more evidence can be obtained. As knowledge in a field advances, new insights and evidence may require changes to existing theories to better align with empirical data and observations (Spirtes et al., 1993). On the other hand, practical considerations, such as the application of theories in real- world scenarios, may lead to changes to improve the utility and effectiveness of theoretical frameworks (Wiland, 2002). This suggests that technological developments, in particular, may lead to changes in some theories and the use of different methods.

Finally, the study analyzed gifted students' perceptions of the scientific method and how they would respond if faced with a choice between two theories. The study revealed that gifted students typically choose the theory closer to the truth when faced with a choice between two theories. Students followed suit, stating that they would opt for the theorythat is more practical in daily life, widely accepted by scientists, and incorporates advanced technology. Given the NOS, selecting the correct theory among the two would be a more accurate approach. On the other hand, since science serves the purpose of facilitating people's lives and is fed by technological developments, it is thought that gifted students choose these criteria in theory selection. However, this view is also acceptable in terms of the NOS, given that the general acceptance of authorities shapes scientific knowledge (Muşlu, 2008).

The primary objective of this research is to evaluate the NOS among intellectually gifted students. The results of the study indicate that these students largely exhibit perspectives that align with the NOS. The examination of studies on students' perspectives on the NOS in the existing literature presents varying results. Meichtry's (1993) literature review indicated that students' understanding of the NOS was largely inadequate. Similarly, studies by Demir & Akarsu (2013), Rahayu (2020), Brenzam Filho et al. (2019) and Yacoubian (2021) also demonstrated insufficient perspectives on the NOS among students. In a study by Mercado et al. (2015), it was found that higher education students had inadequate understanding of the NOS. Conversely, Seçkin's (2013) study showed that students' views on the NOS were acceptable. Other studies have indicated that participation in science-related activities can lead to positive development in students' understanding of the NOS (Deve, 2015; Küçük, 2016; Khishfe & Abd-El Khalick, 2002; Şener, 2018; Tirre et al., 2019; Türköz, 2020). Therefore, it is important to include additional activities in educational programs to improve students' comprehension of the NOS. However, Park et al. (2014), through their research on South Korean and Canadian students, revealed that a multicultural framework effectively influences divergent views on the NOS. This underscores the impact of cultural perspective, as highlighted by Akarsu (2021), on views regarding the NOS. Given this influence, it is crucial to conduct studies that explore the perspectives of students from diverse nations on the NOS to uncover the connection between culture and the NOS.

The study highlights that a majority of gifted students hold the belief that scientific knowledge remains unaffected by scientists' views, presenting perspectives that contradict the fundamental principles of scientific knowledge. Therefore, it is deemed important to implement activities aimed at enhancing students' understanding of the NOS. Nonetheless, the study's limitation to a specific study group underscores the necessity for diverse studies on the evaluations of the NOS among gifted students. Conducting assessments of NOS among gifted students in varied samples can potentially yield results with higher transferability.

Conclusion and Recommendations

The examination presents valuable insights into the perspectives of intellectually gifted students regarding the NOS. Notably, the findings reveal that many gifted students exhibit a pragmatic comprehension of science, recognizing that scientists aspire to progress humanity and pioneer new frontiers. This contradicts the notion that financial incentives serve as the sole motivating factor for scientists. Furthermore, a majority of gifted students maintain that the impact of scientists' viewpoints on scientific knowledge is negligible, suggesting a potential misalignment between students' perspectives and established scientific principles. Conversely, gifted students generally accept the malleable nature of scientific knowledge, demonstrating an understanding congruent with theories emphasizing the evolving NOS.

The investigation indicates that gifted students commonly endorse the pivotal role of observation in the construction of scientific knowledge, while also acknowledging the value of creativity and imagination in the scientific process. This attests to their comprehensive grasp of the observational foundation of scientific knowledge while recognizing the interplay of creativity.

The research elucidates that gifted students perceive various stages such as observation, research, prediction, hypothesis, and experimentation as contributing to scientific knowledge, underscoring their nuanced understanding of the scientific process. Moreover, they acknowledge the significance of imagination and creativity in scientific pursuits, advocating that scientific information should benefit scientists and the general populace alike.

Notably, the study highlights that gifted students ascribe substantial value to experimental and observational evidence in validating scientific knowledge, demonstrating their recognition of the import of experimental evidence. Gifted students recognize the intrinsic influence of scientists' concepts on experimental outcomes, as well as the contributions of technological advancements, inaccuracies, innovative methodologies, and accumulating evidence to the evolution of scientific theories.

The research also reveals that, while gifted students generally espouse viewpoints aligned with scientific principles, further investigations are necessary to examine the perceptions of the NOS among gifted children from diverse cultural backgrounds. This is crucial in refining teaching strategies. Notably, the research recommends:

1) To increase the generalizability of the findings, studies can be conducted with a larger and more diverse sample of gifted students from various regions, socio-economic backgrounds and educational systems.
2) It can be investigated whether cultural differences affect gifted students' NOS perceptions.
3) Longitudinal studies can be conducted to examine how gifted students' NOS perceptions develop over time and at different educational stages.
4) Evaluate the impact of specific educational interventions or curricula designed to improve NOS understanding.
5) Compare the perceptions of gifted students with those of non-gifted students to identify important differences or similarities in understanding NOS.
6) The effects of different teaching methods (e.g., inquiry-based learning, project-based learning) on students' NOS perceptions can be examined.

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Appendix 1: Some Items of the Nature of Science Assessment Scale

1.Why do scientists do science?
A.For more information
B. To find the unknown
C. To acquire knowledge for the benefit of humanity
D. To understand nature
E.Other
....
....
....

5. Scientific knowledge;
A. The more people working on it, the faster it can change
B. Not affected by the number of people working on it
C. It is not affected by the number of people working on it because it does not change
D.Other...
....
....

7. Scientists create scientific knowledge
A. First conducts research, observation, experiment and then hypothesizes
B. First makes research by making predictions and then makes inferences
C. First observation, then research and experiment, hypothesize
D. First observation, research, prediction, hypothesizing, then experiment
E.Other...
....
....

10. Scientists conduct experiments because
A. They want to make new inventions
B. They want to test their ideas
C. They want to prove their ideas
D. They want to find something to help people
E.Other...
....
....

11. Before scientists conduct experiments
A. Know the results of their experiments
B. They do not know the results of their experiments
C. Predict the outcome of their experiments
D. Do not predict the outcome of their experiments
E.Other...
......
....
....

14. When scientists have to choose between two theories;
A. They choose what is closer to the truth
B. They choose what is more useful in daily life
C. They choose the one that is accepted by more scientists
D. They choose the one with more advanced technology
E.Other...
....
....
....

Appendix 2: Distribution of Gifted Students' Opinions on the Items in the Nature of Science Assessment Scale

Item number	1st Opinion	2nd Opinion	3nd Opinion	4nd Opinion	Those who expressed their opinion
1	3	13	24	4	16
2	22	21	7	-	10
3	23	34	-	-	3
4	52	4	-	-	4
5	40	14	4	-	2
6	38	1	5	10	6
7	6	12	3	30	9
8	6	7	40	4	3
9	10	22	1	24	3
10	4	15	16	19	6
11	0	9	47	3	1
12	28	28	-	-	4
13	24	12	7	10	7
14	29	13	7	4	7
15	2	2	56	-	-

*Figures refer to the number of people.