



A Mixed Methods Study on Science Teacher Candidates' Perceptions of the Science Learning-Teaching Process

Fen Bilgisi Öğretmen Adaylarının Fen Öğrenme-Öğretme Sürecine Dair Algıları Üzerine Karma Yöntem Araştırması

İlke Çalışkan^a, Tuğba Özgül^{b1}

^aHacettepe University, Ankara, Türkiye

^bMinistry of National Education, Ankara, Türkiye

Abstract

This study aims to examine candidate science teachers' perceptions of multiculturalism and multicultural education and to determine whether these perceptions differ according to demographic variables. In this study, which adopted a mixed-methods design, quantitative data were collected from 356 teacher candidates using the 25-item "Multiculturalism Perception Scale" developed by Ayaz (2016). The data obtained from the scale were analysed using descriptive statistics, and the scale's Cronbach's alpha coefficient was found to be .920. Qualitative data were obtained through semi-structured interviews with 15 teacher candidates and analysed using descriptive analysis. The findings show that candidate teachers generally have a positive attitude toward multiculturalism, but their knowledge and competence in multicultural pedagogical practices are limited. In addition, conceptual inadequacies were identified in the association of multicultural education with science education. The results highlight the need to strengthen the theoretical and practical content on multicultural education in teacher training programs.

Keywords: Multiculturalism, multicultural education, science education, teacher education, inclusivity in education.

Öz

Bu araştırma, fen bilimleri öğretmen adaylarının çok kültürlülük ve çok kültürlü eğitime ilişkin algılarını incelemeyi ve bu algıların demografik değişkenlere göre farklılaşıp farklılaşmadığını belirlemeyi amaçlamaktadır. İç içe geçmiş karma desenin benimsendiği çalışmada, nicel veriler Ayaz (2016) tarafından geliştirilen 25 maddelik "Çokkültürlülük Algı Ölçeği" ile 356 Öğretmen adaylarından toplanmış; Ölçekten elde edilen veriler betimsel istatistik teknikleriyle analiz edilmiş; ölçeğin Cronbach Alpha katsayısı .920 olarak bulunmuştur. Nitel veriler ise 15 öğretmen adayıyla yapılan yarı yapılandırılmış görüşmeler aracılığıyla elde edilmiş ve betimsel analizle çözümlenmiştir. Bulgular, öğretmen adaylarının çok kültürlülüğe yönelik genel tutumlarının olumlu olduğunu, ancak çok kültürlü pedagojik uygulamalara dair bilgi ve yeterliklerinin sınırlı kaldığını göstermektedir. Ayrıca çok kültürlü eğitimin fen öğretimiyle ilişkilendirilmesinde kavramsal yetersizlikler saptanmıştır. Sonuçlar, öğretmen yetiştirme programlarında çok kültürlü eğitime yönelik teorik ve uygulamalı içeriklerin güçlendirilmesine ihtiyaç olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Çokkültürlülük, çokkültürlü eğitim, fen eğitimi, öğretmen eğitimi, eğitimde kapsayıcılık.

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1. Introduction

The concept of culture forms the basis of the term multiculturalism. Throughout history, culture and the elements that constitute culture have progressed in line with people's lifestyles. Although the concept of culture has many different meanings in the literature, it can be said that the essence of the concept is related to humans and their actions, behaviours, ideas, and belief systems (Gençtürk Erdem, 2022).

*ADDRESS FOR CORRESPONDENCE: Tuğba Özgül, Ministry of National Education, Ankara, Türkiye. E-mail address: tugbaozgul13@gmail.com, ORCID ID: 0009-0007-0979-6710.

İlke Çalışkan, Department of Mathematics and Science Education, Faculty of Education, Hacettepe University, Ankara, Türkiye. E-mail address: ilkeonal@hacettepe.edu.tr, ORCID ID: 0000-0003-4413-8514.

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The concept of multiculturalism is a subject across various disciplines, including sociology, educational sciences, political sciences, and philosophy. It has become a particularly important concept in recent years due to migration, technological developments and social changes. According to Parekh (2002), a multicultural society must develop a political structure that recognises differences while striving to strengthen the bonds that hold society together. Such a policy “requires establishing a satisfactory relationship between unity and diversity by accepting the value of both.” pın, one of the leading theorists of multicultural education, emphasises the importance of maintaining both diversity and unity: “Without diversity, unity results in cultural oppression and hegemony.” Without unity, diversity leads to Balkanization (the division of a large state into small states after civil war) and the fragmentation of the nation-state. In a multicultural democratic nation state, diversity and unity must coexist in a delicate balance” (Coşkun, 2012).

M. Doyhcheva's (2020) definition of multiculturalism is as follows: multiculturalism is a historical political program, intellectual debate, and practical experience based on the idea that modern democracies must recognise different cultures by reshaping their institutions and giving individuals the opportunity to develop and convey their differences.

In today's world, culturally homogeneous communities have been replaced by culturally heterogeneous communities. This situation should not be evaluated only on an individual basis; institutions must also be sensitive to cultural differences. Similarly, when the classroom environment is examined, we encounter students from various cultures who have different advantages and disadvantages (İlbuğa, 2010).

Schools exhibit a microcosmic characteristic. In this sense, schools carry elements of society. Schools also exhibit characteristics of society with all its elements. At the same time, they influence and are influenced by every aspect of life (Yalçınkaya, 2002).

When examined as a concept, “microcosm” means a small world. (Voltan-Acar, 1988) Due to the structure of the school, it can be said that school and classroom management is a microcosm of society. (Yıldırım, 2018)

It is a clear fact that a multicultural educational environment supports pluralistic democracy in terms of fully representing our students in the classroom. Pluralistic democracy is an understanding that considers individuals and groups that are different from each other in every aspect within the social environment and keeps them together by taking these differences into account. From this perspective, pluralistic democracy has created an environment for individuals and societies to live together. When viewed as a whole, schools can also be seen as one of the finest examples of pluralistic democracy (Pınarcıoğlu & Korumaz, 2023).

Individuals acquire their social values and behaviours mostly from their families and educational processes. In this context, educational environments play a significant role in laying the foundations of a multicultural society. Therefore, this research makes an important contribution to understanding the impact of multicultural education on educational environments (Bulut, 2020).

Teachers have important responsibilities in implementing multicultural education. Chief among these responsibilities is the ability to adapt to a constantly changing social structure that encompasses many different cultural elements. Teachers are not merely conveyors of information; they are also individuals who can communicate effectively with students of different languages, cultures, and backgrounds, provide them with a quality education, and serve as role models for society. In addition, they should help their students develop skills such as empathy, communication, and critical thinking so that they can build healthy relationships with people from different backgrounds. This situation increases the importance of pedagogical approaches based on cultural awareness in the education process day by day (Keengwe, 2010). Considering these approaches, it is important to identify teachers' perceptions of multicultural education and develop their competencies in this area.

In his study, Coşkun (2012) aimed to determine and compare the attitudes of prospective Religious Culture teachers toward multicultural education. The sample of his research consists of 219 students who were educated at various universities in Turkey (Atatürk University, Ondokuz Mayıs University, Selçuk University, and Uludağ University Faculties of Theology and the DKAB Education Departments of the Education Faculties of the aforementioned universities) during the 2010-2011 academic year. The research is descriptive in nature and uses a survey model. The study used the Teacher Multicultural Attitude Scale (TMAS) developed by Ponterotto (1998) and adapted into Turkish by Yazıcı, Başol, and Toprak (2009), which has been validated and tested for reliability. The results of the study showed that teacher candidates had positive attitudes toward the concept of multiculturalism, but significant differences were observed depending on the variables identified. These variables were gender, UEE(University Entrance Exam) score, family economic level, parents' educational level, type of educational institution attended, and the nature of the region where the students lived.

In another study examining the personality traits of teacher candidates related to multicultural education, it was stated that a multicultural atmosphere was created as a natural result of political, economic, and technological developments. In this study by Polat (2009), the sample's level of personality traits related to multicultural education was investigated. The sample of the study consists of fourth-year students from the Faculty of Education at Kocaeli University. The research is descriptive in nature. The data for the study were collected using the Turkish adaptation

of the multicultural personality scale developed by Van Der Zee and Van Oudenhoven. The results of the study showed that teacher candidates were considered adequate in terms of multicultural personality traits, but deficiencies were found in the subdimensions of personality. One of the important findings of the study was that the subdimension of emotional balance was not at the desired level. For this reason, it was emphasised that participants should be supported in multicultural education and that training should be provided in this area.

Özdemir (2009) investigated whether teacher candidates' cultural intelligence influenced their attitudes toward multicultural education in their study with teacher candidates. The sample of the study consisted of 485 teacher candidates who studied at Hacettepe University between 2014 and 2015. Two scales were used to collect data. The "Cultural Intelligence Scale" was used to determine the cultural intelligence of teacher candidates, and the "Attitude Scale Toward Multicultural Education" was used to determine their attitudes toward multicultural education. The results of the study showed that the data related to attitudes toward multicultural education and cultural intelligence were relatively high. A significant moderate positive relationship was observed between cultural intelligence and attitudes toward multicultural education. Based on the results of the study, it was concluded that cultural intelligence plays an important role in attitudes toward multicultural education.

Multicultural education is a pedagogical approach in which different cultures, beliefs, languages, and social structures are taught together in learning environments. In the context of science education, the importance of this approach lies in the fact that it not only enables students to learn scientific knowledge but also allows them to develop a more comprehensive understanding by drawing on different cultural perspectives. Multicultural science education develops individuals' scientific thinking skills while also preparing them for the diversity they encounter in a globalising world (Banks, 2015; Gay, 2018).

2. Literature

In the literature, there has been an increasing number of studies addressing the applicability of multicultural education in science teaching. However, most of these studies primarily focus on raising teachers' awareness of multicultural approaches rather than examining the developmental processes of preservice teachers in this context (Ladson-Billings, 1995; Abell et al., 2015). Yet, understanding how preservice teachers perceive multiculturalism and how these perceptions evolve throughout their teacher education is critical. Such understanding provides insights into how future educators can integrate multicultural perspectives into their teaching practices.

In his study titled *Multiculturalism and Science Education*, Taşkın (2019) notes that, although publications on multiculturalism have increased in Turkey over the last decade, these studies often remain at the general education level and do not sufficiently focus on science education. His work includes conceptual and comparative analyses that discuss key notions such as multicultural science, indigenous science, Western modern science, and cultural settings in relation to science education. Through these discussions, the deep interconnection between multicultural education and science education becomes evident, underlining the necessity for teacher candidates to develop an awareness of this relationship.

Moreover, research confirms that preservice teacher education programmes often inadequately prepare candidates for culturally diverse classrooms; for example, in one Canadian study, teacher candidates reported not feeling sufficiently prepared to teach in ethno-racially diverse classrooms and called for more integrative multicultural curricula across courses (Mujawamariya & Mahrouse, 2004). Similarly, Subaşı (2013) found in the Viennese context that although teacher candidates considered their attitude toward multiculturalism a strength, they felt a need for more cross-cultural knowledge, more focused coursework, and more practicum experiences in culturally diverse contexts.

Likewise, in the Turkish context, Kahraman and Sezer (2017) investigated classroom and preschool teacher candidates' opinions about multiculturalism and multicultural education, finding that while candidates defined multiculturalism and multicultural education in terms of "knowing different cultures" and "co-existence of various cultures," their readiness to implement multicultural education in practice was less clear. These findings underscore the importance of assessing teacher candidates' perceptions and readiness for multicultural education as a key component of teacher preparation.

In a similar vein, Iwai (2013) studied pre-service teachers' awareness and attitudes toward cultural diversity through engagement with multicultural children's literature, revealing that after interventions, candidates developed more positive attitudes toward diversity and more intent to use multicultural literature in their future practice. This demonstrates that teacher-education programmes which include targeted interventions can impact preservice teachers' multicultural disposition and potential readiness.

The recent study by Güner and Batı (2024) examined perceptions and competencies of in-service science teachers in Turkey regarding multicultural education. Their findings indicated that teachers with greater age and professional experience had higher levels of multicultural perception and competence, and that increasing teachers' knowledge of

multicultural education positively affects their perceptions of competence. Building on this, it becomes evident that addressing multicultural competence early—in the preservice phase—could help advance such competence before entering the profession.

As Aslan and Aybek (2019) emphasised, multicultural education extends beyond ethnicity or religion to include dimensions such as socio-economic status, gender, and disability. From this perspective, determining preservice teachers' perceptions of multiculturalism becomes a vital step toward preparing them to create inclusive learning environments that embrace diversity in all its forms. Supporting this, Yuan (2018) emphasised in a literature review that teacher education programmes must more robustly integrate multicultural content, develop cultural knowledge and practicum opportunities to prepare teachers for diverse student populations adequately.

Therefore, studies focusing on preservice teachers' multicultural perceptions are essential not only for promoting equity and inclusivity but also for enabling teacher education programmes to design interventions, curricula and practicum experiences that will cultivate culturally responsive and socially just future educators.

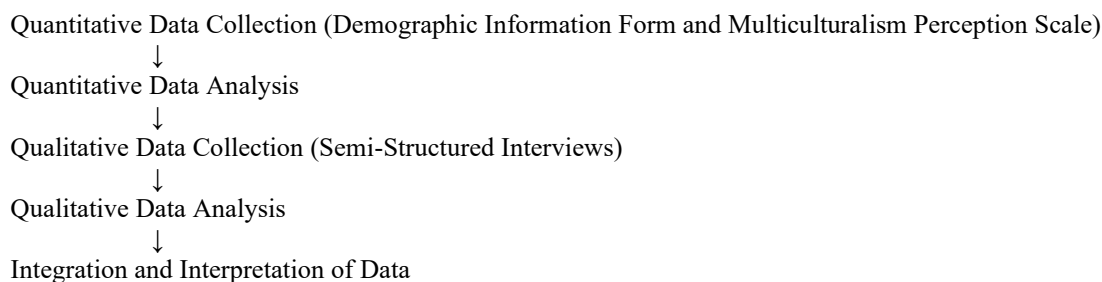
3. Method

This study aims to evaluate prospective teachers' perceptions of multiculturalism and multicultural education. A mixed-methods approach combining qualitative and quantitative research methods and an intertwined mixed design was used in the study. In this context, both in-depth analysis of qualitative data and statistical analysis of quantitative data were used together to provide a more comprehensive and holistic evaluation. This allowed the research to be approached from a broader perspective and richer data to be obtained. In the quantitative part of the study, the descriptive survey technique, which is a quantitative research method, was used.

In the qualitative part of the study, descriptive analysis is used for the interviews conducted with science teacher candidates. In the Descriptive Analysis Method, data obtained through observations and interviews are examined and interpreted (Baltacı, 2019). In descriptive research approaches, data are classified, summarised, and interpreted in line with the themes determined (Karataş, 2015). The descriptive analysis process consists of four stages (Yıldırım and Şimşek, 2021). These are, in order: framework creation, processing of data according to thematic criteria, presentation of findings, and interpretation of findings. The prospective teachers' perceptions of multicultural education were analysed using appropriate quantitative analysis methods according to independent variables (ethnic origin, university, class level, gender, etc.).

This research is based on a mixed methods approach. Mixed-methods research aims to achieve a deeper understanding of research problems by collecting, analysing, and interpreting both quantitative and qualitative data (Creswell, 2012). Within this framework, the study employed the sequential transformative design. According to Creswell (2003), this design allows the researcher to collect qualitative data before quantitative data or quantitative data before qualitative data, depending on the research priorities and paradigmatic stance. The order and emphasis of data collection are determined by the purpose of the study and the researcher's philosophical orientation.

In this study, quantitative data were collected first, followed by qualitative data to further explain and elaborate on the quantitative findings. Therefore, the research followed a “quantitative → qualitative” sequential design. The research design schema is given below;



3.1. Study Group of the Research

The study group consists of 356 science teacher candidates from Hacettepe University and Harran University. Fifty-eight of the participants are male, and 298 are female. Universities in Turkey constitute the universe of the study, while the sample was selected from science teacher candidates studying at Hacettepe University and Harran University. Sixty-one per cent (n=218) of the participants are students at Hacettepe University, while 39% (n=138) are students at Harran University.

In-depth interviews were conducted with 15 teacher candidates. Demographic information about the teacher candidates is presented in Table 1.

Table 1*Demographic Information of the Prospective Teachers in the Qualitative Study*

Participants	Age	Gender	University	University Grade Level	Univ. Entrance Score	Ethnicity	Mother Tongue	Family's Economic Level	Long-term residence of the family	Other
T1	22	Female	Hacettepe University	3	343	Turkish	Turkish	Medium	Central Anatolia	None
T2	20	Female	Hacettepe University	3	393.7	Turkish	Turkish	Medium	Central Anatolia	None
T3	19	Female	Hacettepe University	2	407	Turkish	Turkish	Medium	Mediterranean Region	None
T4	21	Female	Hacettepe University	3	412	Turkish	Turkish	Medium	Southeastern Anatolia	None
T5	21	Male	Hacettepe University	3	401	Turkish	Turkish	Medium	Southeastern Anatolia	None
T6	20	Female	Hacettepe University	2	393.192	Turkish	Turkish	Medium	Mediterranean Region	None
T7	23	Female	Harran University	4	306	Kurdish	Kurdish	Medium	Southeastern Anatolia	None
T8	21	Female	Harran University	4	320	Kurdish	Kurdish	Medium	Southeastern Anatolia	None
T9	21	Female	Harran University	3	321.589	Kurdish	Turkish	Medium	Southeastern Anatolia	None
T10	21	Female	Harran University	3	327	Kurdish	Turkish	Medium	Southeastern Anatolia	None
T11	21	Female	Harran University	4	287	Kurdish	Turkish	Medium	Southeastern Anatolia	None
T12	22	Female	Harran University	4	300	Kurdish	Turkish	Medium	Southeastern Anatolia	None
T13	23	Female	Harran University	4	233	Kurdish	Turkish	Medium	Southeastern Anatolia	None
T14	23	Female	Harran University	4	350	Turkish	Turkish	Medium	Southeastern Anatolia	None
T15	23	Female	Harran University	Graduated	340	Kurdish	Turkish	Medium	Southeastern Anatolia	None

Table 1 shows the demographic information of the teacher candidates who participated in the qualitative part of the study. The participants in this study were 15 teacher candidates who were studying or had graduated from science education programs at two universities in Turkey. Six of the participants were studying at Hacettepe University and nine at Harran University. When examining the participants' university class levels, they are 2nd-, 3rd-, and 4th-year students; only one participant is a graduate. The participants' ages range from 19 to 23. The gender distribution shows that female participants are in the majority. Of the 15 participants, 14 are female, and only one is male. When considering university entrance scores, the participants' scores range from 233 to 412. The participant with the highest score is studying at Hacettepe University and has a score of 412. When evaluated in terms of ethnic origin, eight of the 15 participants are Kurdish, and seven are Turkish. According to the participants' self-reported native language information, only two participants (T7 and T8) indicated Kurdish as their native language; the other Kurdish participants reported Turkish as their native language. All participants reported their family's economic level as "middle class." This indicates a lack of socioeconomic diversity. When examining the distribution of participants based on the regions where their families have lived for a long time, it is seen that 11 participants are from the Southeastern Anatolia Region. Among the participants, there are two from the Central Anatolia Region and two from the Mediterranean Region. This distribution indicates that the sample consists largely of individuals from the Southeastern Anatolia Region. Finally, in the column regarding whether participants had any "other" conditions (e.g., special needs, disabilities, different cultural identities, etc.), all participants selected the "no" option.

3.2. Data Collection Process

Data collection was initiated after obtaining the necessary permissions from the Hacettepe University Ethics Committee. The research was conducted in two phases. In the first phase, the Multiculturalism Perception Scale was administered to assess science teacher candidates' perceptions of multiculturalism and multicultural education. In the second stage, interviews were conducted with 15 science teacher candidates selected through an appropriate sampling method and who volunteered. In these interviews, a semi-structured interview form was used to examine the participants' views on multiculturalism and multicultural science education in depth.

3.2.1. Data Collection Tools

3.2.1.1. Multiculturalism Perception Scale

Two scales were used to collect the data. These are semi-structured interview forms (fourteen questions were asked to 15 pre-service science teachers participating in the study), and the 25-item Multiculturalism Perception scale (ANNEX-1) prepared by Ayaz (2016) was applied to all participants. This is a five-point Likert-type scale consisting of a total of 25 items. It was developed in the 2014-2015 academic year with 194 teacher candidates in the 4th grade of the Ziya Gökalp Faculty of Education at Dicle University. The KMO and Bartlett test results showed that it was suitable for factor analysis. Subsequently, as a result of exploratory factor analysis and confirmatory factor analysis, it was found that the scale had a unidimensional structure explaining 43.127% of the total variance. The Cronbach Alpha value was determined to be 0.942, the Spearman-Brown correlation value was 0.882, and the Guttman Split-

Half value was 0.882. The analysis results showed that the scale had high validity and was found to be valid and reliable in revealing perceptions of multiculturalism.

3.2.1.2. Interview Form

The interview form was created in a semi-structured format consisting of structured and unstructured questions. There are 14 questions in the interview form. It was created by the researcher and prepared by applying for expert opinion.

Semi-structured Interview Form Questions

1. What does the concept of culture mean to you?
2. Can you define the concept of multiculturalism?
3. What does multicultural education mean to you?
4. How do you think multiculturalism elements are emphasised in the learning-teaching process? Can you give an example?
5. What are the components of multiculturalism?
6. What can be done to make the classroom teaching process more efficient for students with different cultural identities?
7. Did you receive training on multiculturalism before your service? Do you think such training is necessary? Why?
8. How can science teachers use multiculturalism elements in their lessons? Can you give examples on a unit and subject basis?
9. What are the teaching strategies, methods and techniques that can be used in multicultural science education?
10. What are the assessment and evaluation methods and techniques that can be used in multicultural science education?
11. Do you think that multiculturalism elements are included in the achievements and activities in the Science Curriculum? Can you give an example?
12. Do you think multiculturalism elements are included in science textbooks? Can you give an example?
13. What are the contributions of multicultural science education to students? Explain.
14. What are your suggestions on the basis of program, textbook and teacher training regarding the knowledge, skills and understandings to be gained in multicultural science education?

Access to the semi-structured interview form was provided to participants via digital communication channels (WhatsApp) through Google Forms. Guidelines on how to answer questions were added for teacher candidates during the interviews, and it was clarified that student names would not be used in the answers.

3.3. Data Analysis

A five-point Likert-type questionnaire was used to assess the perceptions of pre-service science teachers towards multicultural education. The levels of agreement of the scale are 1: Strongly disagree, 2: Disagree, 3: Undecided, 4: Agree, 5: Strongly Agree. The averages of the items in the questionnaire were taken, and these averages were interpreted as 0.80 (5/4) (1.00-1.80 very low, 1.81-2.60 low, 2.61-3.40 medium, 3.41-4.20 high, 4.21-5.00 very high) (Y. Kaya & Söylemez, 2014, p.132). Appropriate analyses were made in the SPSS package program.

If we divide the analysis of the qualitative part of the study into two parts, the first part involved creating themes and codes for the analysis of the data obtained from the semi-structured interview form, and the descriptive analysis method was chosen. 15 pre-service teachers were named as T1, T2, T3.... The findings obtained were presented in tables (Frequency tables) prepared on the basis of the Coded Section (shows how often an expression is included in the documents) in order to minimise the effects that may cause manipulation. The answers given to the interview items were analysed in depth with the content analysis method, and the opinions of the prospective teachers were examined.

4. Findings

1. What are pre-service science teachers' perceptions of multicultural education?

The descriptive statistics of the scale scores of pre-service science teachers' perception of multiculturalism are shown in Table 2.

Table 2
Scale Scores for Perception of Multiculturalism

	Average	Std. Deviation	Level	Cronbach Coefficient	Alfa
Perception of multiculturalism	4,07	0,50	High	0,92	

The average of the scale scores measured for the perception of multiculturalism of pre-service science teachers was found to be 4.07, and it was observed that the perception of multiculturalism of pre-service science teachers was highly positive in general.

The Cronbach's alpha reliability coefficient of the 25-item perception scale, which is a five-point Likert-type scale, was found to be 0.920, which is a high value in terms of internal consistency in the study group.

The rating dimensions of the pre-service science teachers on the items in the scale are shown in Table 3 and interpreted.

Table 3
Number of People Rating the Items in the Scale

Articles		1 Strongly Disagree	2 Disagree	3 Undecided	4 Agree	5 Strongly Agree	Total
01.	ARTICLE 1	14	52	61	138	91	356
02.	ARTICLE 2	2	8	17	149	180	356
03.	ARTICLE 3	0	8	38	154	156	356
04.	ARTICLE 4	7	22	23	109	195	356
05.	ARTICLE 5	6	7	38	159	146	356
06.	ARTICLE 6	4	6	18	160	168	356
07.	ARTICLE 7	12	12	68	167	97	356
08.	ARTICLE 8	11	23	96	155	71	356
09.	ARTICLE 9	11	23	71	163	88	356
10.	ARTICLE 10	7	28	128	135	58	356
11.	ARTICLE 11	1	3	19	208	125	356
12.	ARTICLE 12	8	16	65	165	102	356
13.	ARTICLE 13	7	25	107	146	71	356
14.	ARTICLE 14	7	11	43	194	101	356
15.	ARTICLE 15	9	33	87	153	74	356
16.	ARTICLE 16	4	10	42	160	140	356
17.	ARTICLE 17	5	17	43	166	125	356
18.	ARTICLE 18	9	26	51	168	102	356
19.	ARTICLE 19	7	23	69	164	93	356
20.	ARTICLE 20	4	3	35	188	126	356
21.	ARTICLE 21	3	4	24	163	162	356
22.	ARTICLE 22	1	3	30	171	151	356
23.	ARTICLE 23	5	13	60	156	122	356
24.	ARTICLE 24	1	5	14	153	183	356
25.	ARTICLE 25	6	1	14	127	208	356
AVERAGE		6,04	15,28	50,44	158,44	125,40	356,00
STANDART DEVIATION		3,691	12,030	30,640	20,240	42,128	0,000

If a general comment is made on the data in Table 3, it is seen that the items are particularly concentrated in the "Agree" (4) and "Strongly Agree" (5) categories. This is clearly seen when the averages of these items are analysed. (The averages of the fourth and fifth items are 158.44 and 125.40). This situation tells us that the participants generally

approached the items positively. Option 5 (Strongly agree) has the highest variability value among the categories, with a standard deviation of 42.128, while the variability is lower in categories 3 (Undecided) and 4 (Agree). This shows that the responses are more consistent in these categories. In some items, there is indecision (3). This may be because the participants do not have clear information on the subject. The fact that the options “I disagree” (1) and “I somewhat agree” (2) were marked less may indicate that pre-service teachers do not approach the concept from a negative perspective.

Article 24: “*I believe that people should be able to express their religious beliefs without worry.*”

For the item in question, 153 (4) and 183 (5) respondents selected this item, which was mostly positively received by the participants, while 1 (1) and 5 (2) respondents selected negative answers.

Article 25: “*I believe that students should not see themselves as a lower class because of their culture in the teaching environment.*”

One hundred twenty-seven of the candidate science teachers chose Agree, and 208 of them chose Strongly Agree, which is an item that they supported to a great extent.

Article 8: “*I believe that multicultural education will solve the problems experienced in society due to differences.*” (96)

Article 10: “*I see myself as a multicultural educator.*” (128)

Article 8 (96 people) and Article 10 (128 people) are the options with the highest rate of indecision. It is seen that the common point of these options is multicultural education, which shows us that candidate science teachers do not have a complete consensus on multicultural science education and that they lack knowledge.

Although the majority of the participants had positive opinions about the benefits of multicultural education (e.g. Article 7, Article 9, Article 10, Article 23), the rate of indecision was remarkably high in some items. This may indicate that the participants theoretically support multicultural education but have deep doubts about its implementation and are uncertain about the concrete experience of multicultural education.

Articles 2, 4, 6, 21, 22, 24, and 25 are the articles that the most participants selected as strongly agreeing with.

It is seen that pre-service science teachers generally have positive ideas towards multiculturalism. It is also seen that they support an educational environment that supports diversity, while the significantly high rates of indecision in some items indicate that the participants do not have a clear opinion on certain issues. The articles emphasising the importance of equality of opportunity in education, acceptance of different identities and diversity are highly supported. Although multicultural education is considered to be beneficial, very few of the candidate teachers consider themselves to be a part of the process (Article 10). Although it is seen that candidate science teachers are sensitive to social and cultural dimensions, there are unclear situations regarding the reflection of this perception in the education and training process, putting it into practice and its effects (especially Articles 8 and 13).

During the data collection phase, 15 people were interviewed. Themes were identified in line with the study's purpose, and the findings were analysed using a thematic approach.

The percentage-frequency table for the frequency distribution of the answers given to the scale items is shown in Table 4.

Table 4
Percentage-Frequency Table for the Distribution of Responses

	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
	n	%	n	%	n	%	n	%	n	%
1- It doesn't bother me if people around me speak a different language.	14	3,9%	52	14,6%	61	17,1%	138	38,8%	91	25,6%
2- I respect people no matter what their religious beliefs are.	2	,6%	8	2,2%	17	4,8%	149	41,9%	180	50,6%
3- Teachers need to give each student the opportunity to experience their own cultural values.	0	0,0%	8	2,2%	38	10,7%	154	43,3%	156	43,8%

Table 4 - continued

	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
	n	%	n	%	n	%	n	%	n	%
4- I think it is wrong to treat people according to their social status.	7	2,0%	22	6,2%	23	6,5%	109	30,6%	195	54,8%
5- I see it as a social necessity for different cultures to live together seamlessly.	6	1,7%	7	2,0%	38	10,7%	159	44,7%	146	41,0%
6- I understand that people living in different regions may have different behaviours and opinions.	4	1,1%	6	1,7%	18	5,1%	160	44,9%	168	47,2%
7- I believe that multicultural education is beneficial for students from different ethnic backgrounds.	12	3,4%	12	3,4%	68	19,1%	167	46,9%	97	27,2%
8- I believe that multicultural education will solve the problems related to differences in society.	11	3,1%	23	6,5%	96	27,0%	155	43,5%	71	19,9%
9- I believe that the implementation of multicultural education programs in schools will provide equal opportunities in education.	11	3,1%	23	6,5%	71	19,9%	163	45,8%	88	24,7%
10- I see myself as a multicultural educator.	7	2,0%	28	7,9%	128	36,0%	135	37,9%	58	16,3%
11- I empathise with individuals whose culture is different from mine.	1	,3%	3	,8%	19	5,3%	208	58,4%	125	35,1%
12- I prefer classrooms where multiple cultures have equal rights rather than classrooms where only one culture dominates.	8	2,2%	16	4,5%	65	18,3%	165	46,3%	102	28,7%
13- I think cultural differences can be an advantage for students' academic success.	7	2,0%	25	7,0%	107	30,1%	146	41,0%	71	19,9%
14- I would like to see courses on multicultural education in teacher training programs.	7	2,0%	11	3,1%	43	12,1%	194	54,5%	101	28,4%
15- I do not think that an education that is infused with cultural differences will create social segregation.	9	2,5%	33	9,3%	88	24,7%	152	42,7%	74	20,8%
16- I think that teachers should accept students from different cultures with their own cultural identity.	4	1,1%	10	2,8%	42	11,8%	160	44,9%	140	39,3%
17- The education system should be inclusive of the richness of all ethnic identities that exist in the country.	5	1,4%	17	4,8%	43	12,1%	166	46,6%	125	35,1%

Table 4 - continued

	Strongly Disagree		Disagree		Undecided		Agree		Strongly Agree	
	n	%	n	%	n	%	n	%	n	%
18- I think discrimination based on ethnicity is an important problem in our country.	9	2,5%	26	7,3%	51	14,3%	168	47,2%	102	28,7%
19- I respect people's age-related behaviours.	7	2,0%	23	6,5%	69	19,4%	164	46,1%	93	26,1%
20- I respect people with different ideological ideas.	4	1,1%	3	,8%	35	9,8%	188	52,8%	126	35,4%
21- I think people should be able to disclose their ethnicity without worry.	3	,8%	4	1,1%	24	6,7%	163	45,8%	162	45,5%
22- The teaching environment should be able to meet the needs of students from different cultures.	1	,3%	3	,8%	30	8,4%	171	48,0%	151	42,4%
23- I think multicultural education is too important to ignore today.	5	1,4%	13	3,7%	60	16,9%	156	43,8%	122	34,3%
24- I think people should be able to express their religious beliefs without worry.	1	,3%	5	1,4%	14	3,9%	153	43,0%	183	51,4%
25- I think that students should not see themselves as a lower class because of their culture in the teaching environment.	6	1,7%	1	,3%	14	3,9%	127	35,7%	208	58,4%

According to the table, the statement that candidate teachers (n=208) expressed the most positive opinion on was “I think that students should not see themselves as a lower class in the teaching environment because of their culture”.

Table 5

Category Codes and Explanations According to the Theme of Culture and Cultural Values

Theme	Category	Code	Frequency	Sample Expression
The Concept of Culture	Transfer Format	Transfer of Traditions and Customs Between Generations	8	It is the totality of the material and moral values created by a society throughout history and the way they are passed on to future generations. (T13)
	Material and Moral Elements	Internal Structure	3	In my opinion, culture is the internal structuring of individuals, formed by their values and experiences, which becomes action in various ways. (T2)
		Way of Life	4	Multiculturalism, as mentioned in the question above, can be defined as the diversity of internal structures and actions of individuals due to the diversity of individuals. (T2) The way of life, religion, language, traditions of a society reflect that culture in my opinion. (T3) In short, it can be called a nation's way of life. Everything about the life of a nation is culture. (T8)
	Ethics and Moral System	Relationship between Culture and Identity	6	It is the totality of the material and moral values created by a society throughout history and the way they are passed on to future generations. (T13) Traditions and customs (T14)

Table 5 - continued

Theme	Category	Code	Frequency	Sample Expression
Characteristics of Culture	Sociality	Establishing Moral and Customary Rules	6	What does the concept of culture mean to you? Our customs, traditions, traditions, customs, heritage passed on from the past to the future, the lifestyle we learned from our elders, our language, our religion, our history, our nation, our ceremonies, our holidays constitute our culture. Common values that hold a society together constitute culture. (T7)
		Hosting	1	A society hosts more than one culture. The presence of many cultures in the same living space. (T3)
		Common Values	1	Culture is everything unwritten that describes a society. Types of food, clothing, traditional days, etc. (T11)
	Dynamism of Culture	Take Action	1	... that these different cultures influence each other. (T1)
	Learnability	Transmission through Generations	4	Transferring values and heritage. (T12)
				When I think of culture, the first thing that comes to my mind is that it is an important way of transmitting traditions and customs, especially between generations. I also think that culture is a point of view that reflects our society and sets both moral and customary rules. (T1)
	Variability	Change over Time	2	Culture is our customs and traditions, our identity, which have been passed on to us in the same way or changed since the past. (T4)

In terms of the concept of culture, the internal structure represents the intangible elements of culture, while the way of life represents the material elements of culture. In this respect, the internal structure bears traces of the intangible aspects of culture. We can exemplify these as beliefs, values, norms, traditions and universal perspective. When the Way of Life is analysed, we come across concrete expressions. It includes the tools and equipment used by individuals in life, technological activities, clothing, labour culture, in short, lifestyle elements that can be expressed physically. In short, these two codes cover both the inner world and the external lifestyles of individuals.

Candidate teachers interpret culture as Intergenerational Transmission of Traditions and Customs ($f=8$). The idea that it is transmitted through generations is emphasised. The idea that culture can change over time is dominant. The idea that culture is setting moral and customary rules ($f=6$) is dominant. They also explained culture as a way of life ($f=4$).

Table 5 makes it clear that culture is a multidimensional concept. Culture is considered to be all the elements that constitute the identity of a society and make it different. At the same time, it has a static structure; it undergoes change in modern times while preserving the values of the past due to its structure. Culture is in a state of constant transformation due to this aspect.

Table 6
Candidate Teachers' Perceptions of Multicultural Education

Theme	Category	Code	Frequency	Sample Expression
	Cultural Awareness and Sensitivity	Empathy	5	I think we can best convey this situation to our students through empathy. For example, we can create scenarios with the Demonstration Method in the classroom and ask our students how they feel with both positive and negative scenarios. (T1)
	Teacher Training	Teacher Training	6	In terms of teacher education, we suggest that teachers should learn how to address students from different cultures and how to respect different perspectives. Teachers should be provided with resources to learn about the history of intercultural science and how to adapt it to the classroom. Cultural awareness should also be encouraged by bringing together teachers from different cultures. (T5)
	Competence in terms of Teaching Skills	Various Events	5	Group discussions or collaborative projects can be planned where all students can share their thoughts and experiences. (T13)
	Difficulties Experienced	Negative Interaction	3	I think multiculturalism is inevitable in the geography we live in, so I think multicultural education is very important. In the previous question, I made a comment about the definition of multiculturalism as “the influence of different cultures on each other”. The influence I mean here can be negative, we should try to answer the question “How can we minimize this negative interaction in multicultural education?” and we should learn methods related to this issue. (T1)
	Cultural Communication Skills	Language Support	8	This may include raising awareness among students, providing language support, strengthening empathy and communication skills, ensuring equality in education, organizing activities to introduce and integrate different cultures. (T4)
	Attitudes of Candidate Teachers	Loving, Without Prejudices	5	I believe that it will contribute a lot in terms of our students not being selfish and learning to love. Because there are some examples that I have encountered in my environment that the person has a very big prejudice against those people in different cultures and this situation can sometimes lead to unfair behavior towards that person. I also think that

gaining beauties from different cultures will contribute to our personal development. (T1)

You can try to think like them. At that moment, you can try to look at life through their eyes and manage the teaching-learning process in this way. When an example is given, their values and experiences can also be referred to. (T2)

In Table 6, when prospective teachers think about multicultural education, teacher training (f=6), empathy (f=5), various activities (f=5), an environment full of love (f=5) and an environment without prejudices (f=5) are considered for the formation of a multicultural education environment. Language support (f=8) is emphasised to ensure cultural communication.

2. What are candidate science teachers' views on multicultural science education?

Table 7

Category Codes and Explanations According to the Theme of Multiculturalism

Theme	Category	Code	Frequency	Sample Expression
Fundamentals Principles of Multiculturalism	Tolerance and Respect	Cultural Interaction	6	The coexistence of multiple cultures within a framework of tolerance and respect, and the influence of these different cultures on each other. (T1)
		Appealing to All Cultures	4	A society is home to more than one culture. The presence of many cultures in the same living space. (T3)
	Cultural Richness	Multiculturalism	27	The aggregation of multiple values into a whole. (T12)
		Coexistence of Different Cultures	11	Multiculturalism is the coexistence of societies with different cultures. (T4)
		Coexistence	11	People born and raised in different places coming together. (T6)
				Bringing together people with different characteristics and perspectives(T6)
	Social Inclusiveness	Integration (Harmony)	4	Integration of different cultures(T14)
		Having a Say	1	To have a say in everything (T9)
		Living Your Culture Freely	1	This concept refers to an order in which different ethnic, religious, linguistic and cultural identities are equally valued and individuals are free to live their own cultures. (13)
		Integration of Values	2	The aggregation of multiple values into a whole. (T12)

Table 7 - continued

Theme	Category	Code	Frequency	Sample Expression
Advantages of Multiculturalism		Individual Diversity	1	Multiculturalism, as mentioned in the question above, can be defined as the diversity of internal structures and actions of individuals due to the diversity of individuals. (T2)
	Difference and Diversity	Perspective	6	Culture can be people, societies, perspectives, norms, customs and traditions. (T1)
	Respect	Respect	14	Respect, tolerance, equal rights and justice (T5) Respect, diversity, love, equality, justice, empathy, differences. (T12)
Elements of Multiculturalism	Individuality	Individual	11	Culture, Individual (T2)
		Justice	4	Equality, justice, respect, awareness (T8)
	Equality	Empathy	7	Equality, respect, tolerance, empathy, cooperation. (T3)
		Ethnic Diversity	2	Cultural diversity, equality, cultural interaction, education, tolerance and respect (T13)
		Tradition	14	Ethnicity, religion, belief, linguistic, values, traditions, identity, customs, equality, communication. (T4)
	Traditions and Customs Language, Religion and Beliefs	Language	30	Language, traditions, religious beliefs, age, cultural values, etc. (T11)
		Religion	19	Religion, language, traditions and customs. (T14)
	Cultural Sharing	Fields	2	Information, agenda, different areas (T9)
		Culture	123	Multicultural (T10)
	Social Structures	Family	3	Family structures, region of residence, school of education. (T6)

In Table 7, in order to better explain the issue of multiculturalism (f=27), candidate teachers especially emphasised the concept of culture (f=123). In order to explain and make sense of the concept of culture, a strong relationship is established with elements such as traditions and customs (f=14), language (f=30), and religion (f=19). Multiculturalism is frequently expressed as the coexistence of different cultures (f=11) or cultures together (f=11). The concept of multiculturalism was associated with family (f=3). Among the benefits brought by multiculturalism, the ideas of perspective (f=6), respect (f=14), equality and empathy (f=7) are evident. In terms of the basic principles of multiculturalism, there is a relationship between coexistence (f=11), integration (harmony) (f=4), and living one's culture freely (f=1). Candidate teachers think that there is cultural interaction (f=6).

Table 8*Category Codes and Explanations According to the Theme of Multiculturalism in Education*

Theme	Category	Code	Frequency	Sample Expression
Multiculturalism in Education	Multicultural Classroom	Experience	3	In the classroom environment, individuals with different values and different experiences, and therefore different cultures, learn together. (T2)
		Expresses Self Better	4	Expresses himself/herself in a better way. Ask questions during the lesson without hesitation. (T15)
	Cultural Diversity	Education for Individuals with Different Mother Tongues	3	A system of education for people with different cultures, languages, religions and traditions. In such an education system, for example, children with different mother tongues would also receive education and training in their mother tongue. (T7)
				People from all cultures should be given a voice in the classroom and students from different cultures should be encouraged to cooperate in activities or laboratories. If children have difficulties with language, they should be given mother tongue lessons to help them comprehend the mother tongue of the country they are studying in, and in these additional lessons, simple words of that mother tongue should be used, with one-to-one attention to the students. For example, if an experiment is to be carried out, simple words in the language of the experiment should be used. (T3)
	Family in Multicultural Education	Sensitivity	3	Our esteemed teachers, who are sensitive in all matters, may sometimes experience conflicts between students in the classroom due to some cultural differences. Parents should raise awareness and advise their children on this issue. (T6)
	Different Perspectives of Students	Learning Opportunity	3	They will have the opportunity to learn about science and science in a wider range. They will see the contribution of each race to science. Respect for people and their way of life. (T8)
	Including courses that reflect different cultures in the curriculum	Curriculum Design	4	Including courses that reflect their (different cultural identities) culture in the curriculum and teaching them as compulsory courses would make the education and training process more efficient. (T7)
				The curriculum should include the scientific contributions, discoveries and approaches of different cultures. (T8)
		Cooperation	15	In terms of teaching, the curriculum should include learning outcomes to introduce students to the contributions of different cultures to science. Students should gain the skills to collaborate and think critically in multicultural groups. (T5)

When Table 8 is analysed, when it comes to multiculturalism in education, candidate teachers first mention the existence of a collaborative environment ($f=15$). The idea of a sensitive ($f=3$) environment where students can express

themselves (f=4), where there is equality of learning opportunity (f=3) comes to mind. The idea of education for individuals with different mother tongues (f=3) is dominant. To create a multicultural classroom environment, candidate teachers believe necessary arrangements should be made regarding curriculum design (f=4).

Table 9

Category Codes and Explanations According to the Theme of Multiculturalism in Science Education

Theme	Category	Code	Frequency	Sample Expression
	Intercultural Interaction in Science Education	Internship in Culturally Diverse Regions	2	In particular, at some stage of teacher training, an internship can be organized in a region with different cultures and the prospective teacher can observe for a certain period of time. We can also open a topic related to multiculturalism and increase our focus on the subject. (T1)
		Multicultural Science Education	12	Multicultural science education can bring together students from different cultures through group work and projects. Or activities can be organized to introduce students to the lifestyles, traditions and scientific perspectives of different cultures. (T13)
	Science and Society	Sustainable Cities and Communities	4	In Grade 4 Unit 8, Sustainable Cities and Communities, we can also touch upon the concept of multiculturalism, especially when explaining the concept of community and habitat. (T1)
		Renewable Energy	4	For example, while explaining the topic of energy sources and types, the use of energy sources in different cultures can be compared. For example, wind energy in Scandinavian countries, oil resources in the Middle East, solar energy in India. (T13)
	Ecosystem and Cultural Management	Interaction with the Environment	5	In Grade 3, Unit 8, Journey to the Habitats of Living Things, we can talk about the concept of multiculturalism in the last part of this somewhat concrete topic. We can emphasize that the interaction of people with their environment is very important for increasing the quality of their living spaces. (T1)
	Intercultural Perspective	Humanitarian and Conscientious Value	4	First of all, we should try to explain that the target audience we are trying to reach is not people of a particular race or culture, but simply "people". In other words, we should emphasize to our students that people's race or the culture they are born into is not their choice, and that what is important is that we should have humanitarian and conscientious values and morals. We should also try to explain that such differences are actually beneficial for human perspective and development. (T1)

Teaching Learning Process	Scientific Approaches of Different Cultures	4	Intercultural Discussions: You can ask students to research the scientific approaches of different cultures and present them in class. (T8)
	What are the Teaching Strategies, Methods and Techniques that can be used in Science Education?		Cooperative Learning, Case Study Method, Demonstration Method, Discussion Technique (T1) Expression method in different languages, teaching strategy through research and investigation, and observation as a technique can be made from out-of-class teaching techniques. (T7) I think dilemma cards can be used. (T2)
	Contemporary Measurement and Evaluation Methods	4	Drama, Group or Peer Assessment, Self-Assessment (T1) Portfolio can be used as contemporary assessment. Authentic assessment can also be used. (T7)
	What are the Measurement-Evaluation Methods and Techniques that can be used in Science Education?	1	If a written exam is to be conducted, the questions should be explained in simple words to students who have difficulties with the mother tongue. They can also be given project assignments and be encouraged to cooperate in assessment and evaluation. (T3)
	Problem solving	3	Performance Assessment: Students are encouraged to produce projects for real life problems. Example: Researching and presenting sustainable energy solutions used in different cultures.
	Linguistic Diversity	4	Students can be asked to bring materials from home for experiments and activities inspired by their daily lives. For example, when explaining the digestive system, saying the names of organs in Kurdish as well as Turkish can increase students' interest and curiosity; of course, this practice can also be adapted for Arab, Laz or Circassian students in the class. (T7)
	Diversity and Language		
	Methods of Different Cultures	12	Living Things and Life Unit Topic: Human Body and Health Multicultural approach: Information about different cultures' health systems, medicinal plants and traditional medical practices can be shared. Example: Chinese medicine (acupuncture), Indian Ayurveda system or Middle Eastern herbal medicine. (T8)
	Different Methods		
	Scientific Discoveries in Different Cultures	7	Cultural Themed Experiments: You can show students scientific discoveries in different cultures through experiments. (T8)
	Promotional Events	1	Events and projects promoting different cultures can be organized. (T8)

	Collaborative Work	3	Children from different cultures can be brought together to collaborate on group assignments. (T3)
	Different Scientific Methods	6	I think genetics is a good example of multiculturalism. In that subject, recessive and dominant traits such as hair, eye and skin color are mentioned. From this point of view, we can explain to students that people can have different phenotypes and genotypes, that we do not choose these characteristics ourselves, and therefore no one is superior to anyone else. (T3)
	I cannot reconcile science and multiculturalism.	1	I think it is difficult to use science as a subject that belongs to science, but I cannot reconcile it with multiculturalism.
	Contributions of Multicultural Science Education to Students		
	Coexistence and Harmony	3	I think students will come to school with more enthusiasm and satisfaction because they will find a little bit of their own life. (T7) Students will learn to communicate, work together and cooperate with people from different cultures. (T3)
	Empathy and Social Responsibility	3	It enables not only the learning of scientific knowledge, but also the promotion of cultural diversity, empathy and social responsibility. (T13)
	Mentioned But I Did Not Take Lessons.	2	To be honest, we have not taken such a course, except that our teachers who are sensitive about this issue have mentioned it slightly in their own lessons, and I think it is very necessary. I have friends around me who have heard this concept for the first time. For this reason, I thank you very much for conducting this study. (T1)
	It is a Neglect	1	No, I didn't, but I think it is necessary because as a teacher you will be assigned everywhere and you will meet different people in the society. There will definitely be changes in the culture of these people. I think it is compulsory and the fact that it has not been done until now is a negligence. (T7)
	Education on Multiculturalism is Necessary.		
	Multicultural Science Education should be taught.	4	At this point, I think that in order for teachers not to have problems when they start to work, a training should be given in teacher training to gain knowledge and skills related to multicultural science education. (T2)
Pre-Service Period	Education of Individuals Coming	2	I didn't take it, of course I think it is necessary because, to give a recent example, millions of children who had to

	to Our Country Due to War		leave their countries because of the war were educated in Turkey and of course they had many difficulties in getting used to it. This training can help them to learn a little bit easier. (T12)
Education on Multiculturalism is Not Necessary.	Multicultural Education is Not Necessary.	3	No, I don't find it necessary. (T14) I don't think such an education is necessary, an individual can research and learn about the different cultures they encounter. Our country is already a multicultural country that requires respect for cultures and of course research.. (T10)

When analysed in terms of cultural interaction in science education, candidate teachers hold on to the concept of multicultural science education ($f=12$). In order to ensure this cultural interaction, the idea of internship in different regions ($f=2$) is put forward. When prospective teachers associate multicultural science education with society, they focus on the concepts of sustainable cities and communities ($f=4$), renewable energy ($f=4$) and interaction with the environment ($f=5$). Pre-service teachers emphasise humanitarian and conscientious values ($f=4$) and different scientific approaches ($f=4$). Candidate teachers prefer various scientific methods ($f=6$) and contemporary assessment and evaluation methods ($f=4$) in multicultural science education environments. While the majority of the candidate teachers made a connection between science education and multiculturalism, one candidate teacher thought that there was no such relationship. While the majority of the participants stated that they did not have any definite information about whether the concepts or facts related to multiculturalism were included in the textbooks and curricula, or that the concept of multiculturalism was not included, they also emphasised that they did not conduct sufficient examinations. Almost all of the candidate teachers have encountered the concept of multiculturalism at least once and state that they have not been involved in any systematic training, such as a course or seminar on the concept, during their undergraduate education. While the majority of candidate teachers think that it is necessary to provide training on multiculturalism in the pre-service period, some candidate teachers emphasise that there is no need for such training. While 12 candidate teachers think that multicultural education should be given, 2 candidate teachers state that there is no need for such an education. One candidate teacher abstained.

5. Conclusion and Discussion

A multicultural society is a structure in which different societies embrace each other. This understanding accepts religious, linguistic, ethnic, cultural, and identity differences. (Bahadır, 2016) However, the philosophy of multiculturalism extends to physical differences, sensory differences, and cognitive differences. Otherwise, the idea that the concept only includes cultural processes may arise. In this sense, the concept of multiculturalism is an inclusive structure.

Education plays an important role in the transmission and continuation of culture. In the face of multiculturalism, educational processes are inevitably undergoing change and transformation. In societies where various cultures coexist, education should be restructured as a right that everyone can benefit from equally. (Bahadır, 2016)

The main concept of the study is “multiculturalism,” and this concept has been examined in various ways to form a framework. Evaluations have been made by looking at the concept of multiculturalism from the different perspectives of teacher candidates. While addressing the issue of multiculturalism, answers were sought to questions such as what candidate teachers' perceptions of multiculturalism are and what their views on this issue are, and a framework related to the issue of multiculturalism was drawn. The aim of the study is to understand the perceptions of teacher candidates living within Turkey's multicultural structure and the extent of their awareness in this area. In addition, it seeks to relate multicultural education to science and to make multiculturalism more effective in the education system.

In this study, science teacher candidates' perceptions of multiculturalism were examined in depth using quantitative and qualitative data. The findings generally show that teacher candidates have a positive attitude toward multicultural education, but their knowledge and experience in practice are limited. The average score of 4.07 obtained from the Multiculturalism Perception Scale reveals that teacher candidates have a positive perception of multicultural education. In addition, the Cronbach Alpha coefficient, which indicates the internal consistency of the scale, has a high value of 0.920, demonstrating the reliability of the data.

In particular, the predominance of “I agree” and “I strongly agree” responses indicates that teacher candidates highly approve of multicultural education. However, the high rate of indecision on items such as item 8 (“I believe that multicultural education will solve problems in society related to differences”) and item 10 (“I see myself as a multicultural educator”) indicates that teacher candidates have unclear ideas about multicultural education practices and that their competence in this area is limited. Additionally, the lack of information regarding the presence of multicultural content in textbooks and curricula indicates the need to increase awareness in this area. This finding aligns with the emphasis placed by Gay (2018) and Ladson-Billings (1995) on the need for teacher candidates to be equipped not only with cognitive competencies but also with pedagogical and practice-based competencies.

Qualitative findings show that teacher candidates mostly explain the concepts of multiculturalism, culture, and multicultural education in relation to elements such as tradition, customs, religion, and language. Participants expressed culture in terms of both internal structure (moral and spiritual values) and external structure (material elements and way of life). This multifaceted understanding of the definition shows that culture is perceived at both the individual and societal levels. In addition, teacher candidates emphasise the expressions “coexistence,” “respect,” “equality,” and “empathy” when presenting the concept of multiculturalism.

Another finding from the qualitative data of the research is that while the participants evaluate multicultural education in the context of equal opportunities in education, sensitivity to differences, and acceptance of diversity, they lack sufficient knowledge about adapting multicultural education to teaching programs, textbooks, and learning and teaching processes. This finding shows that teacher candidates are aware of the concept at a conceptual level but have not undergone sufficient preparation in practice regarding multicultural pedagogies (Banks, 2010).

The vast majority of teacher candidates stated that they did not receive systematic training on multiculturalism. The most effective time to provide this training on multiculturalism is before they begin their service.

The main objective of this study is to provide a detailed explanation of the concept of multiculturalism and to gain a broad perspective on multiculturalism by addressing it from different angles. Within the scope of the research, while different definitions of the concept of multiculturalism are provided, teacher candidates also focus on some common concepts. These concepts include: different cultures, coexistence, values, equality, integration, shared life, etc.

In this context, teacher candidates need to internalise the concept of multiculturalism. The study shows that teacher candidates have a positive attitude toward multiculturalism and want to create classroom environments that are respectful of differences and free of discrimination, based on a humanitarian approach, but they do not feel very competent in this regard. This is quite important because even if the concept is understood, it will not be meaningful unless it is put into practice.

In this study, which reveals a positive perception of multicultural education, it is seen that teacher candidates consider multicultural education necessary but have deep concerns about whether they are capable of being such educators. Pre-service education is of great importance for our teacher candidates, who are the future practitioners of education and teaching. The vast majority of teacher candidates stated that they had encountered the concept of “multiculturalism” at least once in their educational lives, but they also stated that they had not received any training or seminars on this subject.

The training provided in this context usually appears at the earliest in the postgraduate period. At the same time, both teachers and administrators need to receive training on this subject for necessary reasons. Therefore, in-service training should be provided. However, these trainings may not be sufficient, so it is of great importance to instil these ideas, values, and concepts in teacher candidates through the training provided to them. Because creating a learning environment where every student can learn at their own pace, express themselves comfortably, know they will not be judged, and not have to make mental calculations to hide their culture and identity—their sense of self—is undoubtedly one of the fundamental goals of multicultural educational environments.

Recommendations:

Multicultural education content should be included in teacher training programs in a more explicit and systematic manner. Interactive lessons, case studies, and application-based activities should be added, especially to increase the practical skills of teacher candidates.

New studies should be conducted with more inclusive samples that increase ethnic and cultural diversity, and the perceptions of teacher candidates from different geographical regions should be examined comparatively.

Seminars, workshops, and in-service training should be arranged for teacher candidates to provide conceptual clarity on multiculturalism. It has been observed that participants have a superficial understanding of some concepts and are unable to apply them.

Multicultural education and inclusive pedagogies should be included in the curricula of education faculties to support teacher candidates in gaining practical skills in addition to theoretical knowledge in this area.

Multicultural teaching practices should be developed specifically for science education to enable teacher candidates to evaluate this field with an interdisciplinary approach.

6. Contribution Declaration

All authors have played an equal role in all stages of the article. All authors have read and approved the final version of the paper. All authors have read and approved the final version of the paper.

7. Conflict of Interest

The authors declare that they have no conflict of interest with any institution or individual within the scope of this study.

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