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TEACHERS' PERSPECTIVES ON TECHNOLOGY USE AND SCIENCE TEACHING FOR STUDENTS WITH MULTIPLE DISABILITIES

Evgin Çay

Abstract. *Students with multiple disabilities often experience difficulties in learning science due to the abstract nature of scientific concepts and their individual learning characteristics. However, technologies that are individualised according to both the characteristics of the content and students' individual needs can facilitate learning in educational settings. Accordingly, the present study aimed to examine special education teachers' perspectives on science teaching and the technologies used to support science teaching for students with multiple disabilities. A qualitative case study design was employed. The participants consisted of ten special education teachers who worked with students with multiple disabilities. Data were collected through semi-structured interviews and analysed using thematic analysis. The findings revealed special education teachers' perspectives on science teaching as well as the technologies they utilised to support science teaching for students with multiple disabilities.*

Keywords: *case study, multiple disabilities, students with multiple disabilities, science teaching, technology.*

Evgin Çay
Balıkesir University, Türkiye

Introduction

Within the population of individuals with special educational needs, some individuals present with a single disability, whereas others experience two or more co-occurring disabilities. In the literature, this condition is referred to as multiple disabilities (MD). Multiple disabilities are characterised by the co-occurrence of two or more disabilities within the same individual. Individuals who have at least two disabilities and are significantly affected by the combined impact of these disabilities are defined as individuals with multiple disabilities (Eldeniz Çetin et al., 2020; Şafak, 2020). Individuals with multiple disabilities have a wide range of needs in their daily lives, one of the most fundamental of which is education. Special education teachers play a critical role in teaching students with multiple disabilities the knowledge and skills necessary to promote independence in daily living and facilitate their meaningful participation in society (Şafak, 2018).

In the education of students with multiple disabilities, instructional priorities have traditionally focused on teaching functional skills that can be applied in everyday life, whereas academic teaching has often received comparatively less emphasis (Mims et al., 2012). However, individuals with multiple disabilities are increasingly expected to assume more complex roles and responsibilities in daily life. To successfully perform such complex tasks and engage in higher-order cognitive processes, including problem solving and critical thinking, students with multiple disabilities need opportunities to acquire academic skills, particularly in mathematics, literacy, and science (Browder & Spooner, 2014). Rather than assuming that students with multiple disabilities are incapable of learning academic content, educators should recognise that these students can acquire academic skills when provided with appropriate instructional methods and individualised technologies.

Students who acquire academic skills gain not only subject-specific knowledge but also develop reasoning, critical thinking, and cause-and-effect reasoning abilities. Therefore, educational programmes for students with multiple disabilities should emphasise the teaching of academic skills alongside functional daily living skills. As opportunities for knowledge ac-

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quisition become sustained and systematic, students' cognitive abilities are further enhanced. Accordingly, the teaching of academic skills should be regarded as a fundamental instructional objective for students with multiple disabilities as well (Kalaylı & Şafak, 2025).

The primary goal of the Science Curriculum is to enable students with special educational needs to develop scientific literacy while taking individual differences into account (Ministry of National Education [MoNE], 2015). In addition, science education aims to equip learners with the knowledge, scientific concepts, and life skills necessary to solve everyday problems, as well as to foster positive attitudes toward science (MoNE, 2018). Science teaching is essential not only for typically developing students but also for individuals affected by disabilities to varying degrees (Karabulut et al., 2021). When students with disabilities are provided with learning opportunities comparable to those available to their typically developing peers, they are able to demonstrate academic achievement in classroom and school settings. Moreover, access to such educational opportunities contributes to their long-term academic success and future career development (National Research Council, 2013).

The cognitive demands of science education, together with the abstract nature of many scientific concepts, may hinder students' ability to process and comprehend scientific information. Consequently, many students experience difficulties during science learning. In addition to students with visual impairments, hearing impairments, learning disabilities, and autism spectrum disorder (Brigham et al., 2011), students with multiple disabilities also encounter significant challenges in learning science. For example, topics such as the formation of rain or the life cycle of a butterfly help students explore their environment and establish meaningful connections between scientific concepts and everyday life. Nevertheless, when appropriate instructional methods and educational materials are employed, science content can also be effectively taught to students with severe disabilities (Şafak, 2018).

A variety of instructional methods, teaching techniques, educational materials, and technologies can be employed to support science teaching for students with disabilities. Among these, technology has emerged as an important tool for supporting students with multiple disabilities across a wide range of educational and developmental domains. Technological tools play a critical role in enabling students with multiple disabilities to interact with their environment and communicate effectively. Because these technologies are grounded in evidence-based educational principles, they facilitate communication, promote social interaction, and support the acquisition of academic skills across diverse learning contexts (Farrell, 2008). Likewise, the integration of technology into science teaching provides substantial support for facilitating science learning among students with multiple disabilities.

A wide range of educational approaches and technology-based interventions can be utilised in science education, including tablet-based applications, direct teaching, computer-assisted education schematic organisers, video-based interventions, the guided discovery model, graphic organisers, constant time delay procedures, and task-analysed education (Karabulut et al., 2021). In addition, advanced technologies, such as virtual reality (VR) applications and materials, can be individualised to accommodate students' unique learning characteristics. Virtual reality applications enable the presentation of complex and abstract scientific concepts in an interactive and detailed manner. By integrating auditory and visual explanations, these applications help make science content more concrete and meaningful for learners (Bilgiç & Aslan, 2025). Furthermore, digital resources, such as audiobooks tailored to science content, can be developed using interactive whiteboards and tablet computers in educational settings, allowing students to access educational content anytime and anywhere. Similarly, digital concept maps can be customised according to students' preferences, including colour, size, and layout, thereby enabling learners to organise and visualise information in ways that best meet their individual needs. Such technologies facilitate learning by making abstract and complex concepts more concrete and accessible (Dexter & Hughes, 2011).

The literature includes numerous studies examining the effects of technology-based and assistive technology-supported education on learning outcomes for students with disabilities (Allen et al., 2012; Burke et al., 2010; Cullen, 2013; Doenyas et al., 2014; Hammond et al., 2010). These studies have primarily investigated the effectiveness of technological tools in supporting education. However, only one study has specifically explored teachers' perspectives on the use of technology in science teaching for students with disabilities (Terzioğlu et al., 2023). In that study, the researchers examined special education teachers' views regarding the use of augmented reality technology in science teaching for students with intellectual disabilities. A review of the literature indicates that no previous study has examined teachers' perspectives on the technologies used in science education for students with multiple disabilities or their experiences with science teaching for this population. Given the importance and potential benefits of technology in facilitating science teaching for students with multiple disabilities, investigating teachers' perspectives is considered both necessary and worthwhile. Insights gained from teachers may contribute to the design of technology-enhanced learning environments and promote the more effective integration of technology to support students' understanding of abstract scientific concepts. Through science teaching, students with

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multiple disabilities can develop skills related to daily living, independence, understanding their environment, problem-solving, and participation in community life. The use of technology can facilitate the development of these skills within the science teaching process. By incorporating technology into science teaching, students can gain greater access to and participation in the learning process. Therefore, it is crucial to identify teachers' perspectives on science teaching and the technologies they use, as well as their needs and the barriers they encounter. Accordingly, the present study aimed to examine special education teachers' perspectives on science education and the technologies used to support science education for students with multiple disabilities. To address this aim, the following research questions were posed:

1. What are special education teachers' perspectives on science teaching for students with multiple disabilities?
2. Which technological tools do special education teachers use in science teaching for students with multiple disabilities?
3. What challenges do special education teachers encounter when using technology in science teaching?
4. What are special education teachers' needs regarding technology integration and science teaching for students with multiple disabilities?

Research Methodology

Design

A qualitative research approach was used in the present study to explore teachers' perspectives on the technologies used in science teaching and on the science teaching process. A case study design was used in the study to provide an in-depth and context-sensitive description of the case within a clearly defined setting. A case study design enables researchers to examine a phenomenon or situation in depth within its real-life context (Yıldırım & Şimşek, 2016). According to Creswell (2007), a case study is a qualitative research approach in which the researcher conducts an in-depth examination of one or more bounded cases over time using multiple sources of data, including observations, interviews, audio-visual materials, documents, and reports, and identifies the cases and themes associated with them. Merriam (1998) classified case studies according to their purposes as descriptive, interpretive, or evaluative. In the present study, a case study was used to describe the participants' perspectives.

Participants

The participants consisted of special education teachers who voluntarily participated in the study and were currently working or had previously worked with students with multiple disabilities. Special education teachers receive coursework related to science teaching as part of their undergraduate education. Participants were selected using criterion sampling, a purposive sampling strategy. The inclusion criteria were as follows: (a) currently teaching in a special education classroom or a special education basic school, and (b) having previously worked with, or currently working with, at least one student who has been diagnosed with multiple disabilities. To ensure participant confidentiality, each teacher was assigned a pseudonym (e.g., T1, T2) throughout the study. The study sample comprised ten special education teachers, including eight females and two males. In qualitative research, the number of participants is generally smaller than in quantitative research because qualitative studies focus on exploring and describing a particular situation or phenomenon in depth. Such research typically focuses on how and why a particular issue or phenomenon occurs (Dworkin, 2012). In qualitative research, the adequacy of the sample size is assessed not in terms of frequencies but in terms of the depth and richness of the data. Accordingly, participants who met the predetermined criteria relevant to the research topic were included in the present study. Prior to the commencement of the study, 14 potential participants were contacted. However, only 10 teachers who met the inclusion criteria volunteered to participate in the study. Detailed demographic characteristics of the participants are presented in Table 1.

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Table 1
Demographic Characteristics of the Participants

Participant	Gender	Age	Highest Degree	Major	Experience Working with Students with Multiple Disabilities (Years)
T1	Female	30	Master's Degree	Special Education	7
T2	Female	25	Bachelor's Degree	Special Education	5
T3	Female	36	Bachelor's Degree	Special Education	15
T4	Female	45	Bachelor's Degree	Special Education	17
T5	Female	37	Bachelor's Degree	Special Education	14
T6	Male	43	Bachelor's Degree	Special Education	12
T7	Female	29	Bachelor's Degree	Special Education	5
T8	Female	35	Bachelor's Degree	Special Education	7
T9	Female	33	Bachelor's Degree	Special Education	10
T10	Male	37	Bachelor's Degree	Special Education	7

T: Teacher

Data Collection Instruments and Procedure

Data for the present study were collected using a semi-structured interview form. The interview protocol was developed based on a comprehensive review of the relevant literature. The interview questions were designed in accordance with the purpose of the study, with particular attention given to ensuring that they were clear and easily understood by the participants. To establish the content validity and clarity of the interview protocol, expert opinions were obtained from three faculty members specialising in special education. Based on their feedback, the interview questions were revised and finalised. A pilot interview was subsequently conducted to evaluate the clarity and comprehensibility of the questions. The interview form consisted of two sections: the first collected participants' demographic information, and the second included eight open-ended interview questions. Prior to data collection, participants were informed about the purpose and scope of the study. The interviews were conducted online. Before each interview, participants were informed that the sessions would be audio-recorded and assured that the recordings would remain confidential and would not be shared with any third parties. The interview questions included in the interview form are presented below.

Interview Questions

1. How do you evaluate science teaching for students with multiple disabilities?
2. What technologies do you use to support the teaching of science learning outcomes?
3. What factors do you consider when selecting the technologies you use?
4. Which technologies used in science teaching do you consider to be more effective? Why?
5. What technologies do you need for science teaching?
6. What are your expectations of school administrators regarding the technologies you need?
7. Could you describe the difficulties you experience when using the technologies you utilise in science teaching?
8. What are your recommendations regarding this issue?

The data were read thoroughly by the researchers, who subsequently developed the initial codes. In addition, the data were independently reviewed and coded by another researcher with expertise in special education and experience in conducting qualitative research. The codes generated by both parties were then compared.

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Data Analysis

The data were analysed using thematic analysis. Thematic analysis is a technique for describing and analysing patterns within data (Braun & Clarke, 2006). It involves analysing a dataset based on similarities, differences, and relationships within the data. The term "thematic" refers to the process of identifying themes that are clustered within the data (Gibson & Brown, 2009). In the present study, the interview transcripts were examined thoroughly, and initial codes were generated by the primary researcher. To enhance the credibility of the analysis, a second researcher with expertise in special education and qualitative research independently reviewed the data and developed a separate set of codes. The coding schemes produced by the two researchers were then compared, and discrepancies were discussed until consensus was reached. Both researchers independently worked on the coding twice and reviewed the codes again. Differences between the codes identified by the two researchers were examined, and consensus was reached on the relevant codes based on the context of the data and the appropriateness of the themes. Following this process, the finalised codes were grouped into categories, which were subsequently organised into broader themes. No further changes were made to the coding scheme during the subsequent analysis process. During the presentation of the findings, direct quotations from the participants were included in italics to support the interpretation of the results.

Trustworthiness and Ethical Considerations

Several measures were implemented to ensure the trustworthiness of the study. To enhance credibility, the interview questions were reviewed by experts in the field, and member checking was conducted. Following each interview, the audio recordings were transcribed verbatim. The interview transcripts were then returned to the participants, who were invited to review the transcripts and indicate whether they wished to make any additions or corrections. To enhance transferability, all stages of the research process were documented and reported in detail. Specifically, the research design, participant characteristics, data collection procedures, and data analysis process were described comprehensively to enable readers to evaluate the rigor of the study and determine the applicability of the findings to similar contexts.

To further enhance credibility, the findings were presented as derived from the data without the inclusion of researcher interpretation. In addition, participants' perspectives were supported through direct quotations. Intercoder reliability was also calculated to assess the consistency of the coding process. Intercoder reliability was computed using the formula: Agreement / (Agreement + Disagreement) × 100 (Miles & Huberman, 1994). According to Miles and Huberman (1994), an intercoder reliability coefficient of at least 80% is considered acceptable. In the present study, the intercoder reliability coefficient was calculated as .96, indicating a high level of agreement between the coders.

Research Results

Theme 1. Science Teaching

Analysis of the findings revealed one category under the theme of Science Teaching, namely Teachers' Perspectives. The participating teachers described science as an abstract and challenging subject, indicating that the curriculum is not sufficiently adapted to students' individual differences. They also emphasised that science teaching is inherently visual and experiment-based and should therefore be supported through the integration of technology. One participant (T5) stated:

> "Science is a highly abstract subject for students with multiple disabilities. Unfortunately, there is no curriculum specifically designed to address their individual characteristics, which makes learning particularly difficult."

This statement highlights the participant's perception that the abstract nature of science poses significant learning challenges for students with multiple disabilities. Similarly, participant T7 emphasised the importance of technology integration in science teaching:

> *"Technology must be incorporated into teaching to help students acquire the targeted skills. Otherwise, both teaching and learning become extremely difficult."*

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This quotation underscores the critical role of technology in facilitating science teaching for students with multiple disabilities. Participant T10 also stressed the importance of experiential learning in science teaching:

> *"To help students acquire the targeted science skills, they need to be actively involved in the learning process through experiments. Science is a subject that should be supported by hands-on experimental activities."*

This finding suggests that teachers perceive science teaching as an educational process that should be grounded in hands-on, experiment-based learning experiences.

Theme 2. Strengths

Under the theme of Strengths, one category, Strengths of the Educational Process, emerged from the data analysis. The participating teachers highlighted several strengths of science teaching, particularly its emphasis on hands-on learning and its relevance to students' everyday lives. Participant T3 stated:

> *"The hands-on nature of science teaching enables students to develop practical skills while learning through direct experience and active participation."*

This statement indicates that teachers perceive the experiential nature of science teaching as an important strength, as it promotes active engagement and meaningful learning for students with multiple disabilities. Similarly, participant T9 commented:

> *"Through science experiments, students are better able to connect the targeted skills they learn with situations they encounter in everyday life."*

This quotation suggests that experimental activities facilitate the transfer of learning by helping students relate newly acquired knowledge and skills to authentic daily-life contexts.

Theme 3. Technology Use in Science Teaching

Four categories emerged under the theme of Technology Use in Science Teaching: Digital Technologies, Artificial Intelligence (AI) Tools, Purposes of Technology Use, and Frequency of Technology Use. The participating teachers shared their perspectives on the technologies they use during science teaching, the purposes for which these technologies are employed, and the frequency of their use. Regarding the use of digital technologies, participant T4 stated:

> *"The interactive whiteboard is extremely useful for helping students acquire the targeted skills. We use it to present science topics and complete instructional activities together."*

This quotation indicates that interactive whiteboards are among the most frequently used technological tools in science teaching. Teachers reported that these technologies facilitate the presentation of science content and support students' acquisition of targeted science skills through interactive learning experiences. The participating teachers also reported using artificial intelligence (AI) tools to support the teaching of targeted skills. Participant T8 stated:

> *"When I encounter a science concept that seems abstract to me or one that I find confusing, I ask ChatGPT for clarification. It has been extremely helpful."*

This quotation suggests that AI tools serve as a valuable source of instructional support by helping teachers clarify scientific concepts before introducing them to their students. Similarly, participant T9 commented:

> *"When I come across concepts that I do not know well or am uncertain about, I use Gemini to learn more about them. It has been very helpful during the science teaching process."*

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This statement indicates that teachers also use generative AI tools as a means of enhancing their own content knowledge and prepare for instruction. In addition, the participants reported using technology to facilitate skill acquisition, increase students' engagement, provide reinforcement, and make education more effective. Participant T7 explained:

> *"Whenever I teach a topic, I incorporate technology into my lessons. It not only makes instruction easier but also captures students' attention."*

Likewise, participant T5 stated:

"Using technology helps students focus and sustain their attention. It also contributes positively to the overall instructional process."

Regarding the frequency of technology use, participant T3 remarked:

"It depends entirely on the content of the targeted skill. Whenever the topic is appropriate, I make sure to integrate technology into my instruction."

These findings indicate that teachers view technology as an integral component of science teaching. Rather than using technology routinely in every lesson, they reported selecting technological tools based on the instructional objectives, the characteristics of the science content, and the individual learning needs of students with multiple disabilities.

Theme 4. Challenges

Four categories emerged under the theme of Challenges: Student-Related Challenges in Science Teaching, Challenges in Technology Use, Challenges Related to Physical Learning Environments, and Teacher-Related Challenges. The participating teachers described a range of barriers associated with science teaching, including challenges related to students, technology use, the physical learning environment, and teachers themselves. Regarding student-related challenges, participant T9 stated:

> *"Because my students have very short attention spans, I experience difficulty teaching the targeted skills. As a result, both the students' motivation and my own motivation tend to decrease."*

This statement highlights limited attention span as a significant barrier to effective science teaching for students with multiple disabilities and emphasises its negative impact on both student engagement and teacher motivation. Similarly, participant T2 commented:

> *"My students are affected by multiple disabilities to different degrees, which results in considerable individual differences. This makes the learning process more challenging."*

This quotation indicates that the heterogeneity of students' educational needs and functioning levels presents an additional challenge for teachers when planning and delivering science teaching. With respect to the use of technology, the participating teachers reported challenges related to insufficient knowledge, limited experience, and the maintenance of technological equipment. Participant T7 stated:

> *"Although I use various digital technologies, I do not have sufficient knowledge about how to use artificial intelligence tools."*

This quotation suggests that limited knowledge of emerging technologies, particularly AI-based tools, may hinder teachers' effective integration of these technologies into science teaching. The participants also identified several challenges associated with the physical learning environment, including the lack of laboratory facilities, insufficient instructional materials, the absence of interactive whiteboards, slow internet connectivity, and inadequate technological infrastructure in schools and classrooms. In this regard, participant T1 remarked:

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> *"We are unable to conduct experiments that should be carried out in a laboratory. Moreover, the classroom environment is not suitable for these experimental activities."*

This statement highlights the importance of adequate physical resources and infrastructure for implementing effective, experiment-based science teaching. Regarding teacher-related challenges, participant T6 explained:

> "At times, I have difficulty maintaining classroom management. As a result, a considerable portion of the lesson is spent addressing students' behavioral issues."

This finding indicates that classroom management challenges may reduce instructional time and limit opportunities for effective science teaching and learning.

Theme 5. Needs

Two categories emerged under the theme of Needs: Professional Knowledge and Training and Needs for Improving Education. The participating teachers emphasised their need for greater knowledge and awareness regarding the effective use of educational technologies. They also highlighted the importance of professional development opportunities, including teacher training programmes and seminars, to strengthen their technological competencies. Participant T10 stated:

> *"I believe that many teachers have limited awareness of educational technologies. Therefore, professional training programs should be organized to improve teachers' knowledge and skills in this area."*

This quotation suggests that enhancing teachers' technological competence through systematic professional development is perceived as a prerequisite for the effective integration of technology into science teaching. Regarding educational improvement, participant T4 commented:

> *"There is a need for concrete educational materials to provide students with a more effective learning environment."*

Similarly, participant T8 stated:

> "To make the abstract concepts in science more concrete, we need technologies and educational materials that engage multiple senses."

These findings indicate that teachers perceive multisensory technologies and concrete educational materials as essential resources for facilitating science learning among students with multiple disabilities.

Theme 6. Expectations

Two categories emerged under the theme of Expectations: School Administration and Colleagues. The participating teachers expressed expectations regarding support from school administrators and their colleagues, particularly in relation to educational materials, professional knowledge, teaching experience, and technological infrastructure, including internet access. Participant T2 stated:

> *"I would like the school administration to support us by providing the materials needed for science experiments."*

This quotation indicates that teachers expect greater institutional support in securing the educational resources necessary for effective science teaching. Similarly, participant T9 commented:

> *"Some of our classrooms do not have internet access. I would like internet connectivity to be provided in all classrooms."*

This statement highlights the importance of adequate technological infrastructure as a prerequisite for integrating technology into science teaching. Regarding support from colleagues, participant T7 stated:

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> "We have colleagues with more teaching experience. We expect them to mentor us, particularly in science teaching and the effective use of technology."

This finding suggests that teachers value collaborative professional learning and peer mentoring as important means of improving instructional practices and strengthening technology integration in science teaching for students with multiple disabilities.

Discussion

The present study examined special education teachers' perspectives on science teaching and the technologies used to support science teaching for students with multiple disabilities. The participating teachers shared their views regarding science teaching, the technologies they integrate into the educational process, the challenges they encounter, their professional needs, and their expectations for improving science education.

The findings of the present study indicate that special education teachers perceive science as an abstract and challenging subject for students with multiple disabilities. The participants also emphasised that, because science teaching is largely experiment-based, it should be supported with visual representations and hands-on activities to facilitate students' understanding. In addition, the teachers reported that the topics and activities included in the science curriculum are not adequately aligned with the individual characteristics and learning needs of students with multiple disabilities. A study conducted by Türker Yıldırım and Yıkmış (2022) examined special education teachers' perspectives on the content of the science textbook. Their findings revealed that the science topics and instructional activities were not appropriate for students' developmental characteristics and ability levels. In this respect, the findings of the present study are consistent with those reported by Türker Yıldırım and Yıkmış (2022), suggesting that existing science curricula and educational materials may not sufficiently address the diverse educational needs of students with multiple disabilities.

The participating teachers reported that the use of augmented reality (AR) technology in science teaching helps make abstract scientific concepts more concrete, enhances the attractiveness of lessons, and supports students' sustained attention. This finding is consistent with previous studies investigating the educational benefits of augmented reality in science education (Abdüsselam, 2016; Seyhan & Küçük, 2021; Taşkıran et al., 2015; Wu et al., 2013). Similarly, Abdüsselam (2016) reported that augmented reality facilitates the concretisation of abstract concepts, thereby enabling students to understand scientific concepts and content more effectively. Furthermore, Terzioğlu et al. (2023) examined special education teachers' perspectives on the use of augmented reality technology in science teaching for students with intellectual disabilities. Their findings indicated that teachers held positive views regarding the integration of augmented reality into science teaching. Taken together, these findings suggest that augmented reality represents a promising educational technology for supporting science teaching for students with multiple disabilities. Accordingly, the integration of augmented reality into science teaching may be recommended as an effective strategy for enhancing the learning experiences of students with multiple disabilities.

Special education teachers encounter a number of challenges during science teaching. According to the findings of the present study, one of the major challenges is related to student characteristics. Teachers reported that students with multiple disabilities often exhibit limited attention spans, experience difficulties in sustaining attention, struggle to understand abstract concepts, and display considerable individual differences in their learning needs and abilities. These challenges negatively affect both the learning process and students' motivation to learn science. Similarly, Terzioğlu et al. (2023) found that special education teachers expected students to demonstrate several prerequisite skills for successful participation in science teaching. These prerequisite skills included the ability to focus and sustain attention, express themselves effectively, and follow instructional directions. Comparable findings were obtained in the present study, particularly with respect to students' attention-related difficulties and the influence of individual learner characteristics on science learning. Therefore, the findings of the current study are consistent with those reported by Terzioğlu et al. (2023).

Sözbilir et al. (2015) reported that research in the field has predominantly focused on instructional materials, disability prevention, academic skills, and variables such as students' interests and attitudes, whereas studies specifically addressing science teaching for students with disabilities remain limited and are largely confined to classroom-based activities. Consistent with this observation, the teachers in the present study identified a range of challenges associated with science teaching. These challenges encompassed student-related factors, difficulties in the use of technology, limitations of the physical learning environment, and teacher-related issues. The findings

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suggest that barriers encountered within classroom and school settings may hinder the effective implementation of science teaching and adversely affect the motivation of both teachers and students. Such challenges may also limit opportunities to provide students with rich, inquiry-oriented, and authentic science learning experiences. Consequently, science teaching for students with multiple disabilities may remain largely restricted to classroom-based activities rather than extending to more diverse and experiential learning contexts.

Another finding of the present study was that students with multiple disabilities experience considerable difficulty during science teaching and, due to their diverse individual characteristics, often struggle to acquire scientific concepts, particularly those that require concrete understanding. On the other hand, the vision of the Science Curriculum emphasises that all students with special educational needs, regardless of their individual differences, should develop scientific literacy (Ministry of National Education [MoNE], 2005). Furthermore, the teachers in the present study identified several educational needs that they considered essential for successful science teaching. They emphasised the importance of frequent and systematic repetition, providing additional educational time, using multisensory educational materials, implementing individualised education, and integrating educational technologies into the teaching process. These findings are consistent with the Science Curriculum, which states that students with multiple disabilities should be provided with sufficient time, increased opportunities for practice, appropriate instructional methods, and suitable assessment approaches to support the development of scientific literacy skills (MoNE, 2005). Taken together, these findings suggest that effective science teaching for students with multiple disabilities requires individualised, multisensory, and technology-supported educational practices that are responsive to students' diverse learning needs. Such practices may enhance students' access to science learning opportunities and contribute to the development of meaningful scientific literacy skills.

One of the most salient findings of the present study concerns the professional needs of teachers. The participants reported a need for greater knowledge and competence regarding the use of educational technologies in science teaching. Specifically, they indicated that they lacked sufficient knowledge about the effective use of certain technologies designed to support science teaching, and that these knowledge gaps limited the quality and effectiveness of the educational process. The teachers further emphasised the need for professional development programmes and seminars focusing on technology integration and digital competence. Addressing the professional development needs of teachers working with students with multiple disabilities is likely to contribute not only to teachers' instructional competence and ongoing professional growth but also to the quality of educational services provided to students with multiple disabilities. Therefore, the findings underscore the importance of designing and implementing systematic professional development opportunities that specifically address technology integration in science teaching for this population.

Students with severe and profound disabilities may experience substantial difficulties in acquiring scientific concepts within educational settings (Karakoç, 2016). Because many science concepts are inherently abstract, they may be particularly challenging for these students to understand. Educational techniques and materials grounded in systematic education have the potential to enhance students' learning outcomes and facilitate concept acquisition (Scruggs et al., 1998). The science teaching process can be strengthened through the integration of educational technologies, concrete educational materials, multisensory instructional resources, and individualised educational practices. In addition, graphic organisers may serve as an effective educational support for students with multiple disabilities during science teaching. Graphic organisers help students organise, integrate, and visually represent newly acquired information, thereby making abstract concepts more concrete and meaningful. Supporting this perspective, Bilgiç and Şafak (2021) employed graphic organisers delivered through direct teaching to teach science concepts to students with multiple disabilities. Their findings demonstrated that the targeted learning objectives were successfully acquired by the participating students. These findings suggest that combining evidence-based educational approaches with appropriate instructional supports may enhance science learning for students with multiple disabilities.

The participating teachers reported that they utilise both digital technologies and artificial intelligence (AI) tools to support students' acquisition of targeted skills during science teaching. These technologies were perceived as user-friendly resources for both teachers and students and were considered valuable for making abstract scientific concepts more concrete while providing more authentic and engaging learning experiences. Such findings highlight the potential of digital and AI-supported technologies to enhance the accessibility and effectiveness of science teaching for students with multiple disabilities. The frequent use of these technologies during science teaching may also reflect teachers' efforts to align instructional practices with students' individualised educational needs. Accordingly, incorporating technology-based supports into students' Individualised Education Programmes

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(IEPs) and integrating them systematically into science teaching may facilitate the achievement of individualised learning objectives and improve students' engagement and learning outcomes.

The findings of the present study should be interpreted within the educational context of Türkiye. In Türkiye, the education of students with multiple disabilities is largely shaped by inclusive education policies and special education practices within the national education system. Therefore, teachers' experiences with science teaching and their use of technology may be influenced by contextual factors, such as the availability of technological resources, access to professional development opportunities, and the level of institutional support provided to teachers. The difficulties reported by the teachers in the present study may therefore reflect not only the individual characteristics and educational needs of students with multiple disabilities but also broader contextual conditions within the Turkish education system. From an international perspective, these findings contribute to the literature by highlighting the importance of considering educational and contextual factors when examining technology use in science teaching for students with multiple disabilities. Although the specific educational policies, resources, and support systems may differ across countries, the need for accessible technologies, teacher training, and context-sensitive approaches to science teaching is likely to be relevant across diverse educational settings. Thus, the findings provide a context-specific perspective from Türkiye while also offering broader implications for researchers and practitioners seeking to promote equitable access to science education for students with multiple disabilities.

Conclusion and Implications

The findings indicate that special education teachers use a range of technology-based and digital tools when teaching science to students with multiple disabilities. However, the findings also reveal that teachers experience student-related, educational, technological, and environmental challenges during the processes of science teaching and technology integration. In addition, teachers reported professional development needs related to the effective use of educational technologies. They also indicated a need for greater institutional support in terms of educational resources and technological infrastructure. These findings suggest that the effective use of technology in science teaching depends on access to pedagogically sound professional development opportunities and adequate institutional support. In terms of instructional practice, the findings indicate that professional development programmes should provide teachers with practical opportunities to enhance their technology use skills. Furthermore, educational institutions need to strengthen their technological infrastructure and provide accessible educational resources to facilitate the implementation of technology-supported science teaching. Future research should examine in greater detail how specific technologies can be integrated and used in the science teaching process. In addition, the effectiveness of professional development programmes and technology-based teaching approaches across different educational settings should be investigated.

Limitations and Recommendations for Future Research

Despite its contributions to the literature, the present study has several limitations that should be acknowledged. First, the study included a relatively small sample of ten special education teachers who participated on a voluntary basis. Although qualitative research does not aim to produce statistically generalizable findings, including a larger and more diverse group of participants could have provided a broader range of perspectives and enriched the findings. Second, the interviews were conducted online during the summer break. While this format may have allowed participants to express their views more comfortably, it may also have limited the depth of interaction between the participants and the researcher compared with face-to-face interviews. Future studies may address these limitations by recruiting a larger number of participants and conducting in-person interviews to facilitate richer data collection. In addition, whereas the present study focused exclusively on the perspectives of special education teachers, future research could also investigate the views and experiences of science teachers regarding science teaching and technology integration for students with multiple disabilities. Such research would contribute to a more comprehensive understanding of interdisciplinary practices in science education for this population.

Ethical Approval

This study was conducted in accordance with the ethical standards of the relevant institutional review board. Ethical approval was obtained from Balıkesir University Social and Human Sciences Research Ethics Committee, Approval No. 2026/07-37 Date: 29.07.2026

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Data Availability Statement

Data are available from the corresponding author upon reasonable request.

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Evgin Çay PhD, Department of Special Education, Necatibey Faculty of Education, Balıkesir University, Balıkesir, Türkiye.
E-mail: evgin.cay@balikesir.edu.tr
ORCID: https://orcid.org/0000-0002-1199-3939