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Needs Analysis of Teachers Providing Science Education to Visually Impaired Students and Their Students

Mirac Furkan BAYAR[1]
Ministry of National Education
Özlem AĞGÜL [2]
Ministry of National Education

Abstract

The aim of this research is to identify the needs of teachers providing science education to visually impaired students and their students and to develop various solution proposals based on these needs. The study involved 1 Science teacher, 2 Special Education teachers, and 10 visually impaired students from a state primary and middle school in the center of Erzurum province. The research design followed a qualitative approach with a case study design. The data collected were analyzed using content analysis. The findings revealed that the needs of teachers providing science education to visually impaired students fall into two themes: needs arising from the teacher and needs influenced by external factors. Similarly, the needs of visually impaired students were categorized into two themes: needs arising from the students themselves and needs influenced by external factors. Teacher-related needs included the need for concretization and description, material design, individualized instructional selection, technological proficiency, and the ability to activate sensory organs. External factors affecting teachers' needs included the need for materials, laboratories, reference books, appropriate training, in-service training, parental cooperation, and personalized curriculum. Student-related needs encompassed education environment and methods, technology and assistive tools, family support and counseling services, physical accessibility in the school environment, alternative and augmented communication in education, and psychosocial support. External factors affecting students' needs included social interaction, academic motivation, academic achievement and exam anxiety, special education and counseling services, note-taking and organizational skills, and daily living skills.

Keywords: Visually impaired students, science education, teacher needs, student needs

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[1]Dr., Ministry of National Education, Erzurum, Turkey, ORCID: https://orcid.org/0000-0002-0693-4280
Correspondence: miracfurkanbayar@hotmail.com

[2] Science Teacher, Ministry of National Education, Erzurum, Turkey, ORCID: https://orcid.org/0000-0002-2185-2478, Email: ozlm.aggul@gmail.com

Introduction

From a young age, individuals have a natural tendency to observe, think, and explore nature and events around them. This natural inclination leads individuals to seek answers to their questions by understanding basic scientific concepts (Trundle, 2010). This need for learning about science and exploration of natural phenomena applies to visually impaired individuals as well (Mastropieri & Scruggs, 1995). Considering the principle of equal opportunities in education, the needs of visually impaired individuals to receive quality science education must be addressed (Kavkler, 2005). A quality science education for visually impaired students enables them to perceive the world according to their senses, make decisions based on their perceptions, solve daily life problems, and develop their experiences and skills (Mastropieri & Scruggs, 1995).

Visually impaired students face limitations in acquiring knowledge through visual senses, making them dependent on special education. Vision is considered the most crucial sense in today's visually-oriented society (Kermauner, 2014). Approximately 83% of all information is learned through sight, while the remaining 17% is acquired through other senses. Of this 17%, 11% comes through hearing, 3.5% through smell, 1.5% through touch, and only 1% through taste (Stolovitch & Keeps, 2014). Consequently, visual impairment constitutes a significant obstacle to cognitive and social development, dulling personal abilities and making knowledge acquisition more challenging (Bailey & Wning, 1994). Minimizing the negative effects experienced by visually impaired students in their learning environments depends on meeting various needs in these environments. One of these needs is the needs of teachers responsible for educating these students.

Science education for visually impaired individuals holds great importance for their academic, social, and emotional development (Ediyanto & Kawai, 2019). Science education is a tool used to understand and explore natural and environmental sciences (DeBoer, 2019). It ignites curiosity about nature and the environment and fosters an interest in science among students (Russell & Martin, 2023). In science classes, students develop scientific thinking and exploration skills through experiments and observations. Visual impairment prompts visually impaired students to use their other sensory organs more effectively (Wild & Allen, 2009). By relying more heavily on touch, hearing, and smell, they can explore the world. Science education helps visually impaired students understand their surroundings better, enabling them to be more independent and effective in their daily lives. Providing science education to visually impaired students boosts their self-confidence (Rosenblum et al., 2019). By conducting experiments and achieving success in science classes, students' self-confidence can be positively influenced. It contributes to improving their scientific thinking skills, understanding everyday events, and increasing their self-assurance. Science education allows visually impaired students to have a closer relationship with science and nature, leading them to lead more conscious lives (Wild & Paul, 2012). Therefore, science education is of great importance not only for all students but also for visually impaired students.

When reviewing the relevant literature, various studies have identified the needs of visually impaired students in their learning environments (Bargerhuff, 2013; Flair & Setzer, 1990; Gürsel, 2012; Hashman et al., 2013; Mackowski et al., 2020; Okcu et al., 2016; Sözbilir et al., 2015; Supalo et al., 2009; Ruin et al., 2020; Teke & Sözbilir, 2019). These studies have highlighted the importance of concrete objects and materials, tactile-designed models, Braille-written textbooks and notes, activating other senses, and accessible laboratories as essential needs for visually impaired students' learning. However, it has been observed that the needs for providing visually impaired students with more quality science education have not been extensively examined at the elementary level and have remained limited at the middle school level. Moreover, specific studies focusing on both teachers and students' perspectives are lacking.

Therefore, the purpose of this research is to identify the needs of teachers providing science education to visually impaired students and their students and to develop various solution proposals based on these needs. By conducting a needs analysis among teachers actively involved in the field, in line with their thoughts, and by addressing the needs of students together, this study aims to support the provision of more quality science education for visually impaired students. To achieve this goal, the following research questions were addressed:

1. What are the needs of teachers providing science education to visually impaired students?

2. What are the proposed solutions for meeting the current needs of teachers providing science education to visually impaired students?

3. What are the needs of visually impaired students?

4. What are the proposed solutions for meeting the current needs of visually impaired students?

Method

In this section, the research model, study group, data collection tool, and data analysis are described.

Research Design

This study adopts a case study design to explore the needs of teachers providing science education to visually impaired students and their students and to propose solutions for addressing these needs. Case studies are conducted to deeply investigate events or phenomena beyond the researcher's control, addressing the "why" and "how" questions (Meriam, 2013). Additionally, case studies are based on process-oriented research methods that focus on a bounded event or phenomenon related to daily life (Yin, 2009). As a qualitative research method, case study involves data collection techniques such as observation, interviews, and document analysis, to present perceptions and events in a natural and comprehensive manner (Aspers & Corte, 2019). In this research, the case study design adopted is Yin's (2009) holistic single-case design. The holistic single-case design focuses on a single unit of analysis

and aims to confirm or refute a theory, study exceptional cases, and investigate previously unexplored topics (Creswell & Creswell, 2017).

Study Group

The study group was determined using purposive sampling, a method that enables in-depth exploration of situations believed to possess rich information. Homogeneous sampling, a sub-method of purposive sampling, involves selecting a small and similar sample representing a distinct subgroup (Creswell & Creswell, 2017). In this research, homogenous sampling was employed to obtain information from individuals (teachers providing science education to visually impaired students and the students themselves) sharing common characteristics. For this purpose, a total of 3 teachers and 10 visually impaired students from a state primary and middle school in Erzurum province participated in the research. Data were collected through semi-structured interviews. Table 1 provides information about the teachers, while Table 2 includes details about the students.

Tablo 1. *Information of the Teachers Participating in the Study*

Coding	Gender	Seniority	Branch	School
*T1	**F	3	Science Teacher	***VIS
*T2	**F	8	Science Teacher	***VIP
*T3	**F	2	Science Teacher	***VIP

* T: Teacher, **F: Female, M: Male, ***VIS: Visually Impaired Secondary School, VIP: Visually Impaired Primary School

Tablo 2. *Information of the Students Participating in the Study*

Coding	Gender	Age	Class	Visual impairment
K1	Girl	12	5	Low Sight
K2	Girl	15	8	Low Sight
K3	Male	14	7	Low Sight
K4	Male	11	4	Low Sight
K5	Girl	15	8	Heavy Level
K6	Male	11	4	Heavy Level
K7	Girl	14	7	Heavy Level
K8	Male	10	5	Heavy Level
K9	Girl	12	5	Blindness
K10	Male	15	8	Blindness

Table 1 shows that all participants are female. The professional experiences of teachers providing science education to visually impaired students range from 2 to 8 years. Among the teachers

at this school, one is a Science teacher, and two are Special Education teachers. One teacher works at the Visually Impaired Middle School, while the other two work at the Visually Impaired Primary School. The participants are coded as T1, T2, and T3. As seen in Table 2, a total of 10 visually impaired students participated in the study, with 5 female and 5 male students. Among them, 4 students have severe visual impairments, 4 have low vision, and 2 are blind. The students are coded as K1, K2, K3, K4, K5, K6, K7, K8, K9, and K10.

Data Collection Process

In qualitative case studies, commonly used techniques for data collection include interviews, observations, and document analysis (Creswell & Creswell, 2017). In this study, semi-structured interviews were conducted to reveal the views of teachers and students. The use of semi-structured interviews allowed the participants to express their interests, views, attitudes, and behaviors comprehensively, enabling in-depth information gathering on specific topics (Aspers & Corte, 2019). The initial interview questions were developed after a literature review and then refined based on the input of experts in the field of educational sciences. Permission was obtained from the teachers to record their interviews, which were approximately 20 minutes long and conducted face-to-face at their school, adhering to ethical guidelines. The interviews were audio-recorded using a recording device. The participants were provided with information about the interview technique, and a conversation protocol was employed during data collection. Through these interviews, in-depth information was gathered concerning the needs of teachers providing science education to visually impaired students. A group focus interview was conducted with the 10 participating students. A discussion guide was prepared for the group focus interview, and the form was finalized after consultation with three experts in special education and a thorough review of the literature. The students participated voluntarily.

Data Analysis

To interpret and achieve insights into the obtained data, content analysis was utilized in this research. Content analysis involves coding similar concepts, grouping codes into categories, and further organizing them into themes. The data obtained from content analysis were processed in four steps: (1) coding the data, (2) finding categories, (3) organizing codes and categories, and (4) describing and interpreting the findings (Aspers & Corte, 2019). The purpose of data analysis is to convey the meaning contained within the collected data. During this process, the researcher combines what the interviewees said and what the researcher understood from their statements (Meriam, 2013). The data collected from the participants were first transcribed and then deciphered using open coding to identify valuable information related to the research questions (Merriam, 2013). Additionally, the direct input from the participants' statements was included to enhance the credibility of the study. The reliability of the coders is a reliability criterion used in qualitative research. The data collected from the data collection tools were transcribed, and based on the aim and problems of the research, they were analyzed. The data were coded using the assistance of the Maxqada program. The codes were then compared with the codes

obtained from the literature review to create themes, categories, and codes. The consistency of the participants' expressions during the interviews was examined and compared with the observations and audio recordings. The reliability between the coders was analyzed using the formula proposed by Miles and Huberman (1994), which is based on agreement and disagreement of views. A reliability of over 70% is recommended among coders in qualitative research (Miles and Huberman, 1994). In this research, the reliability for the needs of teachers providing science education was found to be 93%, and for the needs of students, it was found to be 95%. These results indicate the reliability of the data among coders.

Validity and Reliability of the Research

In qualitative research, all applied procedures should be credible, convincing, and capable of providing accurate and justifiable results to subsequent researchers and readers. Therefore, attention is given to validity and reliability throughout the research process, including the establishment of the conceptual foundation, data collection, and analysis, as well as the interpretation of the findings (Merriam, 2013). In this context, to enhance the validity and reliability of this research, the researcher appropriately adjusted the interaction time in line with the nature of the research and the characteristics of the data sources, critically examined the relevance of the collected data to the research questions, and sought support from experts at every stage of the research. Additionally, the obtained data were shared with the participants for verification. Moreover, detailed descriptions and direct quotations were used to provide the reader with a perspective on similar environments and the process. The validity and reliability measures taken in this research are presented in more detail in Table 2.

Tablo 3. P*recautions for Validity and Reliability*

Precautions	Type
Getting expert opinion on qualitative research, interviews with participants based on long-term interaction, sharing the findings with the participants	Internal validity (credibility)
Making a detailed description by giving direct quotations about the interviews, making a purposeful sampling	External validity (transferability)
Presenting the obtained data to the reader without adding any comments, comparing the analysis made by the researcher with the analysis made by the expert.	Internal reliability (consistency)
Detailed description of the sample group, storage of raw and processed data	External reliability (Confirmability)

Results

The findings related to the first two sub-problems of the research, namely "What are the needs of teachers providing science education to visually impaired students?" and "What are the proposed solutions to meet the current needs of teachers providing science education to visually impaired students?" were analyzed using descriptive and content analysis based on the data obtained from semi-structured interviews. The needs of teachers providing science education to visually impaired students were categorized under two themes: needs arising from the teachers themselves and needs stemming from external factors. A total of 61 codes and 12 categories were identified based on the themes derived from the teachers' views.

The data obtained through the semi-structured interview form are presented in Table 4. Each view expressed by the teachers is indicated by codes such as T1, T2, and so on. Additionally, the frequency (f) with which each view was shared by the teachers is also presented.

Tablo 4. *Needs of Teachers Giving Science Education to Visually Impaired Students*

Theme	Categories	Codes	Teacher Codes	f
Teacher-Generated Needs	The need for concretization and description	The necessity of concretizing the lesson more compared to normal students	T1, T3	2
		The necessity of explaining the visuals to the total student more clearly	T1	1
		Strengthening expression skills towards concretization	T1	1
		Concretization of learning content	T1	1
	The need for material design	The problem of creating a model suitable for the student	T1, T3	2
		Designing materials suitable for different vision levels in the same lesson	T2	1
	The need to be able to choose education that suits individual differences	Failure to balance the teaching needs of total and low vision students	T1, T2	2
		Method selection suitable for individual differences	T1, T2, T3	3
		Inability to manage time according to the student's disability type	T2	1
		Teaching difficulty due to not knowing Braille for total student	T3	1
	The need for technological competence	Transfer of appropriate technologies to the classroom by the teacher	T1, T2	2

	The need to activate the sense organs	Designing tactile and auditory activities	T1, T2	2
Needs from External Factors Affecting Teachers	material need	Defects due to lack of material	T1, T2, T3	3
		Ready-made materials according to achievements	T1	1
		The necessity of having 3D materials	T1	3
		The necessity of having audio materials	T1, T2, T3	1
		Large model and pictures	T1	1
		Technological materials	T2	2
			T2, T3	
	Laboratory Need	Experimenting embodies learning	T1, T3	2
		Lab supplies draw attention	T1, T2, T3	3
		Customized laboratory for the visually impaired	T1, T2	2
		Problems of outsourcing test materials	T1, T2	2
	Resource book needs	Reproduction of effective textbooks and reference books	T1	1
		Qualifying Braille books	T1	1
		Diversified books for total and low vision students	T1	1
		Books that explain or sound visuals in detail	T1	1
		The fact that the student with low vision has to read the book to the total student	T2, T3	2
		Lack of large print books	T2	1
		Picture books created separately for visuals		
	Need for appropriate undergraduate education	Few courses for special education in undergraduate education	T1	1
		Ineffectiveness of special education courses in undergraduate education	T1, T3	2
		Difficulty in creating appropriate teaching method	T1	1
	Need for in-service training	The importance of in-service training in the lack of undergraduate education	T1	1
		Raising awareness of in-service training	T1	1
	The need for parent cooperation	Insufficient family resource book support	T1	1
		Insufficient family support for homework	T1	1
		The family sends the student to school prepared	T2	1

	Education should continue at home	T3	1
The need for a customized curriculum	Insufficient time for the lesson	T2	1
	Special program for disability type	T2	1
	The unnecessaryness of being responsible for the same curriculum as normal students	T2, T3	2
Total			61

Upon examination of Table 4, it can be observed that two themes related to the needs of teachers have emerged. Under the theme of "needs arising from the teachers themselves" prominent codes include "selection of methods suitable for individual differences, the necessity of making the lessons more concrete compared to regular students, challenges in creating suitable models for students, difficulty in balancing teaching approaches for students with total and low vision impairments, integrating appropriate technologies into the classroom, and designing tactile and auditory activities." Another identified theme is "needs stemming from external factors affecting teachers," with prominent codes such as "challenges arising from material shortages, the necessity of having three-dimensional materials, and the attention required for laboratory materials."

Participants generally emphasized that for enhancing the quality of science education for visually impaired individuals, they have needs related to "tailoring instruction to individual differences" and "ability in concretization and illustration." Regarding this matter, T1 expressed their views by stating, "For example, when demonstrating the dissolving of sugar in water, I can show it to a student with low vision, but not to a student with total vision impairment. At that moment, what happens is that I help them understand through explanation. For example, the student with low vision can see that the sugar particles have separated a bit more, but the totally blind student cannot see it. So, they cannot perceive such tiny details." T2 shared their thoughts, "We have both low vision and totally blind students in our classes. That's why we need to teach with enlarged fonts and pictures for low vision students. However, for the totally blind students, we need to present it tactilely, and this requires dividing the lesson into two parts."

Participants also pointed out that their needs regarding the enhancement of science education for visually impaired individuals pertain to "material needs, laboratory needs, and the need for reference books," which are factors external to them. For instance, T2 stated, "Yes, yes, as I said, since I cannot provide it tactually, I try to create materials in the classroom myself. I make and bring them home and try to share them with the students. However, of course, since these materials are not produced by the material development center, they are not durable and cannot be used in the long term. They are only sufficient for teaching that particular topic on that day." T3 shared their thoughts, "For instance, having a laboratory would make students more curious. Curiosity is the beginning of learning for children. A

laboratory environment makes the education more enjoyable and turns them into more curious learners. For the curious ones, more effective, lasting, and efficient learning can be achieved. Moreover, a laboratory setting allows children to learn in a more concrete way."

To address the third and fourth sub-problems of the research, which are "What are the needs of visually impaired students?" and "What are the proposed solutions to meet the current needs of visually impaired students?", the findings obtained from the focus group discussions were analyzed using descriptive and content analysis. Based on the students' views, a total of 35 codes and 12 categories were identified, forming various themes.

The data obtained through the focus group discussions are presented in Table 5. Each view expressed by the students is indicated by codes such as K1, K2, and so on. Additionally, the frequency (f) with which each view was shared by the students is also presented.

5. *Needs of Visually Impaired Students*

Theme	Categories	Codes	Student Codes	f
Needs arising from external factors affecting students	Educational environment and methods	• Special education schools and integration process Classroom arrangements and accessibility measures •Use of tactile and sensory learning materials	K1, K2, K3, K8, K10	5
	Technology and assistive tools	• Braille printers and training materials Use of audiobook and screen reader software The role of mobile applications in education	K1, K2, K5, K6, K8, K9	6
	Support and guidance services for families	• Participation and experience of families in the education process •The importance and impact of guidance services • Emotional processes of families for visually impaired students	K3, K5, K6, K8, K9, K10	6
	Physical accessibility in the school setting	• Disability suitability of school buildings and classrooms In-school guidance and safety of visually impaired students • Barrier-free library and learning spaces	K1, K2, K3, K4, K5, K6, K8, K9, K10	9
	Alternative and increased communication in education	• Use of Taktile maps and graphics The role of sign language and touch language in education The effect of multimodal communication methods	K3, K4, K5, K6, K8, K9, K10	7

Student-Based Needs	Psychosocial support	•Emotional support of teachers for students and psychosocial support services The effect of the educational environment on students' emotional well-being and coping skills The role of social support networks on student success and well-being	K1, K2, K5, K6, K7, K10	6
	Social interaction	Friendship relations of visually impaired students • Self-esteem and self-confidence development •Participation in social activities and experiences Social isolation and adaptation difficulties	K1, K2, K3, K4, K5, K7, K10	7
	Academic motivation	• Students' academic goals and motivational factors • Achievement orientation and self-efficacy belief • Motivational strategies that affect academic performance	K1, K2, K4, K5, K6, K8, K9, K10	8
	Academic success and test anxiety	• High expectations and academic pressure Exam anxiety and performance worries • Stress factors related to lecture notes and assignments	K1, K2, K5, K6,	
	Special education and guidance services	• Evaluation of individual characteristics of visually impaired students • Training and competence of special education teachers and specialists •Future planning and vocational guidance services	K1, K2, K3, K4, K5, K8, K9, K10	8
	Note taking and organization	• Anxiety about not getting lecture notes • Anxiety about not being able to organize lecture notes	K1, K2, K3, K4, K5, K6, K9,	7
	Daily living skills	• Kişisel bakım gibi konularda yardıma ihtiyaç duyma • Boş zamanlarında yeterli aktivite yapılmaması	K2, K5, K6, K8, K9, K10	6

When examining Table 5, the needs of visually impaired students were categorized under two themes: needs arising from the students themselves and needs stemming from external factors affecting the students. The needs arising from the students themselves were identified as educational environment and methods, technology and assistive tools, support and guidance from families, physical accessibility in the school environment, alternative and augmented communication in education, and psychosocial support. On the other hand, the needs stemming from external factors affecting the students were

determined to include social interactions, academic motivation, academic achievement and exam anxiety, special education and guidance services, note-taking and organization, and daily life skills.

Regarding the needs stemming from external factors affecting visually impaired students, first, examples of student interviews related to the educational environment and methods were provided:

"...I am a visually impaired student receiving education in a special education school... Some materials and content in the lessons were not organized in a way that suited me, and as a result, my learning process could be affected…" (K1)

"...I have difficulties with Braille alphabet... Moreover, most of the materials at school are not written according to the Braille alphabet, which is a big problem for me..." (K8)

The data indicate the importance of special education schools providing education tailored to specific needs and integration, which play a crucial role in enhancing understanding and solidarity among individuals with different abilities.

Examples of student interviews related to technology and assistive tools were provided:

"...Technological tools such as smart boards played a significant role in my learning process... However, I faced challenges in using technology and assistive tools sometimes, as there could be technical issues that led to delays in my lessons or assignments..." (K2)

"...Through the computer, I can easily communicate with my friends and interact with them on social media platforms..." (K5)

The data highlight that technology and assistive tools facilitate visually impaired students' access to information, promote independence, and support their active participation in social life. The use of technology and assistive tools can help visually impaired students maximize their potential and achieve success in their educational journey.

Examples of student interviews related to support and guidance from families were provided:

"...I feel like my family is not sufficiently involved in decisions regarding my education. I wish they would show more interest in my thoughts and contribute to the plans related to my education and future..." (K6)

"...I feel like my family does not follow my academic achievements and progress. Their indifference can negatively affect my motivation. I need support to perform better in my education, but I can't find that support from my family..." (K9)

The data show that family involvement is crucial for visually impaired students to have a successful educational experience and positive contribution to their development. Families should play an active role in their children's education by providing support and guidance tailored to their specific needs.

Examples of student interviews related to physical accessibility in the school environment were provided:

"...My access to special education materials is also limited. Braille books or technological tools are not adequately available at our school, and this makes it difficult for me to access lesson content. This leads to falling behind in lessons and facing difficulties in my learning process..." (K4)

"...The lack of arrangements regarding physical accessibility in our school creates obstacles in my educational journey and hinders my independence in daily life..." (K8)

The data explain the impact of physical accessibility arrangements in the school environment on visually impaired students' education. The absence of physical accessibility arrangements can negatively affect their academic independence and success, whereas the presence of such arrangements positively influences their learning process, allowing them to learn effectively and independently.

Examples of student interviews related to alternative and augmented communication in education were provided:

"...I wonder about the place where I live... I heard about tactile maps on the internet, but we don't have those maps at our school..." (K3)

"...I can sometimes face difficulties in classroom communication. My teachers and classmates may not always be understanding when communicating with me. Communicating with those unfamiliar with alternative communication methods can also be challenging..." (K9)

The data emphasize the importance and impact of alternative and augmented communication methods for visually impaired students. While effective alternative and augmented communication can enhance their educational experience, any inadequacies or deficiencies can make it difficult for them to participate on an equal footing with others. Providing additional support and attention can help visually impaired students succeed in their education.

Examples of student interviews related to psychosocial support were provided:

"...There is not enough guidance and psychological support available at our school. The lack of guidance services makes me feel emotionally isolated and negatively affects my social relationships..." (K1)

"...Sometimes, I try to cope with exam anxiety, but I can struggle to overcome it. Even after achieving success, my exam anxiety can quickly be replaced by new anxieties related to the next exam..." (K6)

The data demonstrate that psychosocial support is a vital factor aimed at enhancing emotional and social well-being. Visually impaired students may face different challenges compared to their peers, making psychosocial support essential in helping them cope with emotional difficulties and maintain

motivation. It is crucial to prioritize guidance services and develop Individualized Education Programs (IEPs) to support students in their educational journey.

When examining the needs arising from visually impaired students themselves, first, examples of student interviews related to social interactions were provided:

"...My shyness in social interactions sometimes leads me to interact less with my friends. I feel hesitant to speak in the classroom or during social activities, which makes social interactions challenging for me..." (K5)

"...Being misunderstood or excluded by my friends in a group affects me negatively. Not being able to act as I wish during social interactions and not being accepted can make me feel lonely in my educational journey..." (K10)

The data reveal that positive social interactions support students' active participation in the learning process and academic success, while negative interactions can lead to feelings of loneliness and decreased motivation.

Examples of student interviews related to academic motivation were provided:

"...Lately, my interest in the lessons has decreased, and my willingness to study has declined. I fear failure in exams, which prevents me from studying more. I find it difficult to focus on studying, which frustrates me..." (K4)

"...The decline in my academic achievements causes a sense of hopelessness rather than motivating me. Struggling to achieve my previous successes can make it hard for me to exert more effort and can lead to a loss of self-belief..." (K6)

The data highlight that academic motivation is an essential factor aimed at increasing students' interest in learning and their desire for success. Visually impaired students may face different challenges compared to their peers, making it especially crucial to support their academic motivation and encourage them to have a successful educational experience.

Examples of student interviews related to academic achievement and exam anxiety were provided:

"...I have excessive anxiety about exams, and this anxiety can negatively affect my study habits. I find it challenging to focus on exams and can get distracted. This makes it harder for me to achieve success..." (K1)

"...Although I try to cope with exam anxiety, I can sometimes find it difficult to overcome. Even after achieving success, my exam anxiety can quickly be replaced by new anxieties related to the next exam..." (K6)

The data indicate that exam anxiety may be more pronounced for visually impaired students due to different challenges they face. Physically arranging exams and providing necessary support can help alleviate exam anxiety and have a positive impact on students' achievements.

Examples of student interviews related to special education and guidance services were provided:

"...I do not receive enough guidance support to cope with emotional difficulties. The lack of guidance services makes me feel emotionally isolated and negatively affects my social relationships..." (K3)

"...In an environment where guidance services are not adequately provided, I believe I could have a more positive experience in my educational journey..." (K9)

The data highlight that special education and guidance services encompass a range of important services aimed at meeting students' specific needs and supporting their academic, social, and emotional development. Special attention should be given to guidance services, and students should receive Individualized Education Programs (IEPs) to cater to their individual needs.

Examples of student interviews related to note-taking and organization were provided:

"...I know that I need to take notes to be successful in my studies and effectively learn the information, but I find it difficult to excel in this aspect..." (K2)

"...I find it challenging to take notes in class and maintain a consistent note-taking system. This prevents me from reviewing and revisiting lesson content, hindering my exam preparation and academic achievements..." (K4)

The data reveal that note-taking and organization skills are essential for students to manage their educational processes more efficiently and successfully. Visually impaired students may face specific challenges in accessing materials and information, making note-taking and organization skills particularly crucial. Developing these skills can help students excel in their studies and improve their academic performance.

Examples of student interviews related to daily life skills were provided:

"...I struggle with time management and planning. Balancing school, studying, and other daily tasks can be challenging, leading to feelings of stress and anxiety..." (K5)

"...My deficiencies in daily life skills make it difficult for me to succeed in my educational journey and affect my self-confidence. I need support to acquire better daily life skills..." (K10)

The data emphasize that daily life skills are essential for visually impaired students to enhance their independence and self-confidence. Teaching and supporting daily life skills for visually impaired students can help them perform tasks more independently, ultimately improving their quality of life.

Discussion, Conclusion and Recommendations

The needs of teachers providing science education to visually impaired students were categorized under two themes: needs arising from the teachers themselves and needs stemming from external factors affecting the teachers. Similarly, the needs of visually impaired students were also categorized under two themes: needs arising from the students themselves and needs stemming from external factors affecting the students. The needs arising from the teachers themselves were identified as the need for concretization and description, the need for material design, the need to select instruction suitable for individual differences, the need for technological proficiency, and the need to activate sensory organs. The needs stemming from external factors affecting the teachers included the need for materials, the need for laboratory facilities, the need for reference books, the need for appropriate teacher training, the need for in-service training, the need for parental collaboration, and the need for personalized instructional programs.

In conversations with teachers providing science education to visually impaired students, it can be asserted that, as seen in Table 4, teachers' needs primarily arise due to external factors. Under this theme, the most recurring issues are "challenges arising from the lack of materials, the necessity of three-dimensional materials, and the attention required for laboratory equipment." Science education inherently demands the use of materials and conducting experiments. For visually impaired students' education, the need for materials is crucial to support their learning and provide them with a better educational experience (Tsinajinie et al., 2011). Educational materials of visually impaired students should be suitable for their sensory perception and learning needs (Cox & Dykes, 2001). Some of these materials can be classified as Braille books, audio books, special software and applications, tactile (touch) materials, and special education tools. Selecting and using materials according to the needs of visually impaired students is important for a more qualified science education. At the beginning of these materials needed are 3D materials. 3D materials help visually impaired students embody abstract concepts, better understand and experience science subjects. Examples of 3D materials are the use of tactile models to teach visually impaired students about subjects such as molecular structures, organs, planets or vegetative structures, the development of models suitable for students to better understand subjects such as the structure of the cell and DNA molecule through 3D printing technology, the printing of Braille labels to facilitate laboratory use, the development of tactile graphics to make the graphics touchable and tactile (Rule et al., 2011). Therefore, the access of visually impaired students to 3D materials in science education helps them to better understand and experience science subjects. It is seen that another important need arising from external factors in science education of visually impaired students is the need for laboratories. Laboratory experiments enable students to experience science topics concretely, make observations and improve their scientific thinking skills (Caldwell & Teagarden, 2007). These experiments enable students to understand science topics not only theoretically but also practically. In this context, it is very important that there are science laboratories in schools

where visually impaired students receive education and that educators make necessary arrangements by supporting the active participation of visually impaired students in laboratory experiments (Ediyanto, & Kawai, 2019).

The study conducted to address the needs of teachers and students involved in science education for visually impaired students reveals another prominent theme, namely "teacher-related needs." Under this theme, the most recurring issues are "selection of methods tailored to individual differences, integration of appropriate technologies into the classroom, and the challenge of creating a suitable model for the student." These needs arise from the teacher's side and require resolution.

The difficulty in selecting methods tailored to individual differences in science education for visually impaired students varies depending on factors such as the degree of visual impairment (severe, partially sighted, etc.), the student's different learning styles, abilities, and interests (Narwal, K., & Sharma, 2018). The ability to address this need and select the most suitable methods for visually impaired students depends on the teacher's knowledge, skills, and competencies, as well as their close collaboration with the students. Another important teacher-related need in science education for visually impaired students is the integration of appropriate technologies into the classroom. In this context, the teachers' technological proficiency is of great importance (Ajuwon et al., 2016). Using technology effectively provides teachers with the necessary tools to support the education of visually impaired students. Hence, it is essential for teachers to be curious, explore, and understand accessible technologies, special software, and digital resources available for visually impaired students.

Moreover, another significant teacher-related need in science education for visually impaired students is the challenge of creating a suitable model for the student. Developing models in science education for visually impaired students is a crucial step to help them understand and experience scientific concepts. Teachers who possess the skill of material development and dedicate time to it can enhance students' understanding of subjects and increase their participation (Phutane et al., 2022).

Education environments and methods for visually impaired students should be arranged in a way that caters to their special needs (Fraser & Maguvhe, 2008). The educational setting must be physically accessible, with arrangements that allow for unhindered movement and easy access to materials for students (Kocyigit & Artar, 2015). Educational methods should be adapted to enable students to learn effectively through non-visual means. Education can be provided using tools such as Braille alphabet, audiobooks, and tactile maps. Teachers should develop individualized education programs that cater to the specific needs of students and provide a supportive learning environment. Technology and assistive tools play a crucial role in accessing materials and information (Bilyalova et al., 2021). The use of technology and assistive tools facilitates students' educational processes and contributes to their independence (Tohara, 2021). Screen readers and Braille keyboards enable visually impaired students to use computers more efficiently. Audiobooks facilitate students' access to course materials and can support them in taking more efficient class notes. Family support and guidance are

significant factors in the education of visually impaired students. Active involvement of families and providing emotional and social support to students are important (Davis, 2013). Families should show interest in their children's education and approach their special needs sensitively (Wolffe, 2019). Guidance services provide families with the necessary support and guidance on how to best support their visually impaired children. Physical accessibility of the school environment is essential for students. Arrangements such as accessible toilets, adequate lighting, guiding systems, and smooth flooring should be made. Schools should create an environment where students can move around effortlessly. Physical accessibility eases students' school experiences and contributes to their independence (Brown et al., 2013). Alternative and augmented communication methods in education for visually impaired students are vital for more effective learning (Boster et al., 2021). Effective communication facilitates students' educational processes and increases their access to information. Students receiving psychosocial support enhance their emotional well-being and self-confidence. Psychosocial support addresses students' emotional needs and boosts their self-confidence (Phukubje, 2019). Guidance services play a significant role in this area and provide emotional support to students. In conclusion, education environments and methods for visually impaired students, along with technology and assistive tools, family support and guidance, physical accessibility in the school environment, alternative and augmented communication in education, and psychosocial support, contribute to their successful completion of the educational process and enable them to lead independent lives. The data obtained in this study are supported by the literature, and properly addressing these factors allows visually impaired students to fully develop their potential and enhance their participation in society (Fedulova et al., 2019). Families, teachers, school administration, and guidance counselors can contribute to the achievements and happiness of visually impaired students by adopting a supportive approach towards them.

For teachers providing science education to visually impaired students, it is crucial to approach their special needs with sensitivity and create a supportive learning environment for them. Classroom arrangement and laboratory settings should be designed to allow visually impaired students to move comfortably and access materials easily. Proper arrangements must be made to enable visually impaired students to use laboratory equipment and actively participate in experimental work. Non-visual educational tools and materials should be used for science lessons. Tools such as audiobooks, tactile maps, and 3D models facilitate students' access to course content. Teachers can conduct experiments and observational studies in non-visual ways and encourage active student participation. Alternative communication methods can be utilized to effectively communicate with visually impaired students. Teachers can present course materials using Braille alphabet or verbally to assist in their understanding. By understanding students' specific needs, teachers can create personalized learning plans. Tailoring education methods to students' learning styles can enhance their achievements. Providing education to visually impaired students using technological tools is essential. Screen readers, Braille keyboards, and audio materials enable students to access course content more easily. Teachers should actively support

students in their learning processes and study sessions. Answering questions, providing guidance, and instilling a sense of confidence can boost their motivation. When planning laboratory activities, teachers should design experiments that ensure students' safety and enable them to participate effectively. Particularly, using tactile and auditory sensory materials allows students to engage in experimental work more efficiently. Ensuring equal opportunities for visually impaired students to participate in in-class activities, discussions, and group work is essential. By sensitively approaching the special needs of visually impaired students and fully developing their potentials, teachers can enhance students' achievements. Seeking support from educational and guidance experts in this regard is important. Moreover, collaborating to provide better educational opportunities for visually impaired students can improve their learning experiences.

Policy Implications

This article has the potential to contribute to educational policies by focusing on both teacher- and student-related needs in science education of visually impaired students. It is important to revise the legal regulations and regulations in education to raise the standard of education for visually impaired students in order to increase the goals of equality and inclusion. The findings that illuminate the needs of visually impaired students in these two dimensions in science education provide a more contemporary and participatory orientation. Science course is one of the basic subjects in secondary school. Therefore, making this course accessible to everyone strengthens the principle of equal opportunity in education and gives every individual the right to quality education. Integrating customized materials, technological tools and methods for visually impaired students into the education system enables these students to benefit from their educational rights at the highest level. In this way, students' potential to develop higher-level thinking skills such as scientific thinking, analytical problem solving and creativity increases. It is expected that the needs revealed by the research will guide the making of new arrangements in terms of content in the current programs of these types of students. Developing and providing easy access to resources such as audiobooks, tactile materials and specially created laboratories for visually impaired students creates an environment that supports learning. In addition, adding more content regarding the education of visually impaired students in teacher training programs is important for both teacher candidates and teachers to better understand these special needs and increase their competencies. It is thought that this article will contribute to current educational problems and future educational theory and practices in the international context.

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Credit Author Statement

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