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# Science Education Needs of the Individuals with Intellectual Disabilities

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## ABSTRACT

Science class is essential since it covers numerous daily life-related subjects; thus, every student should learn science topics effectively. This study aimed to determine the science education needs of students with intellectual disabilities. While identifying these needs, the study considered 'the teaching approach of some matters in solid-liquid-gaseous states' as the basis. It also followed the case study research design, one of the qualitative research approaches. The sample was identified by the purposive sampling method. Four students with intellectual disabilities enrolled in a special education class in a secondary school involved the teaching approach of some matters in solid-liquid-gaseous states. Researchers collected the data through interviews with three special education teachers and one science teacher and through in-class and out-of-class observations in a special education school and two secondary schools retaining special education classes. The collected data were analyzed using the content analysis method. As a result, this study identified both educational-teaching needs and needs for the educational-teaching environment of students with intellectual disabilities.

**Keywords:** Science education, intellectual disabilities, needs analysis, special education

## Introduction

Intellectually disabled individuals may engage in social life to a limited extent. These individuals constitute a sizable proportion of individuals with special needs, and their participation in educational environments is increasing steadily. Hence, for these individuals to effectively participate in educational settings and receive satisfactory education, eliminating the difficulties they experience in accessing educational environments and social living spaces and satisfying their physical needs in educational environments is necessary (Ergün, 2005; Uşaklı, 2009). Indeed, it is crucial to take the required measures by considering education, training, and learning needs to ensure the efficacy and efficiency of the education provided (Yazıcı et al., 2021). The regulations and supports required by individuals with special needs are also similar to those without such needs (Ministry of National Education [MEB], 2006). Therefore, it is critical to identify the requirements of individuals who need special education for effective education.

Need recognition refers to determining a problem or deficiency encountered and selecting a systematic and logical solution to such cases (Kaufman & English, 1979; Witkin, 1994). Determination of education, teaching, and learning needs constitutes the first step in preparing an educational program. The process also involves setting fitting targets in line with the identified needs and includes the planning of the curricula in line with these targets, the teaching process based on the targets and content, and an evaluation process to specify to what extent these targets have been achieved (Karacaoğlu, 2009). Therefore, the need recognition process becomes critical and effective in determining the current educational status and how it should be (Şahin, 2006).

Both national and international laws and agreements include the right to education for individuals with special needs. With the contribution of these laws and agreements, the participation of these individuals in the education-training environment is growing every day. At every educational level, the United Nations Convention on the Rights of Persons with Disabilities (2008) ensures the inclusion of students with special needs in education and their right to education. The constitution of the Turkish Republic also retains similar guarantees. Article 42 of the constitution emphasizes that no student, including individuals with special needs, can be deprived of the right to education and training. Similarly, Article 15 of the Disability Law declares the necessity of including students with special needs in education by considering the types and levels of their disabilities, particularly emphasizing that nothing shall restrain these students from receiving education for any reason. As a result, these statements explicitly reveal the educational needs of these individuals.

Students with intellectual disabilities have similar learning goals to their peers without disabilities (Yazıcıoğlu & Kızılaslan, 2021). They can benefit from education in preschool and primary school classes. They also can learn to read and write in these classes and acquire some of the knowledge and skills they need in science and mathematics courses (Eripek, 2011; Tekinarslan, 2017). These newly acquired knowledge and skills will contribute to meeting the swiftly changing and developing scientific knowledge, rapidly advancing technology, and the increasing impact of science and technology on human life in this direction (Keşan & Kaya, 2008). It is impossible to disregard rapidly evolving scientific knowledge and technology independently of science since science education will enhance intellectual and creative skills (İşman et al., 2002). The educationally developed countries have reflected the concept of “science for individuals” in their educational curricula. For instance, the American National Research Center emphasizes that age, gender, culture or ethnicity, type, and level of disability variables are insignificant and that all students in the education system should receive equal science education (National Research Center [NRC], 1996). Correspondingly, the Turkish educational vision of all individuals to be scientifically literate has been adopted for science courses (MEB, 2018). These data explicitly suggest that individuals with intellectual disabilities should receive science education, and science education should be in the education-training programs of individuals with mental disabilities.

After determining the need for education and deciding how to provide these services, it is crucial to identify the needs in the environment and establish proper educational settings based on these needs to provide suitable education and enable students to progress in line with their interests, desires, skills, and their development attributes (Avcılar, 2010). While establishing these environments, it is also vital to pay attention to the suitableness of educational environments for science education/training and general teaching (Durmaz et al., 2022). Additionally, when establishing proper settings for science education, teachers should consider students' disparities and needs. In line with these disparities and needs, science teaching materials relevant to students' learning abilities, learning speeds, development levels, and types of disabilities should be prepared (MEB, 2005). Indeed, these individuals learn concrete concepts or subjects more easily than abstract ones (Mastropieri & Scruggs, 2015/2016; Tekinarslan, 2017). Yet, there should be laboratories available in science teaching environments for concrete learning because, among the science teaching methods used, the laboratory method is one of the most effective methods in terms of increasing success in students, solving problems, and developing a positive attitude toward science (Seven & Engin, 2018; Sıdal et al., 2023). Laboratories also play a crucial role in learning science topics or concepts meaningfully and ensuring learning permanency since these settings enable students to engage in activities based on doing and experiencing. Yet again, with laboratory practices, students put the learned information into practice, develop their manual skills, and learn to work and share together (Ayas, 2006; Kırpık & Engin, 2009). An educational environment organized based on student needs will be effective in terms of creating positive communication and interaction between these students and their peers (Avcılar, 2010).

In the context of learning needs, the Science Course Curriculum, which was prepared by taking into account the needs and mental development of individuals with intellectual disabilities, involved the learning topics, including matter and change, living things and life, physical phenomena, the world, and the universe (MEB, 2001). Raising scientifically literate students is the primary function of science education. Individuals should receive a science education based on their mental competence, taking into account their intellectual development (Kaptan, 1998). In his research on teaching science to individuals with intellectual disabilities, Mete (2016) determined that these individuals can learn some science topics and concepts, suggesting that such individuals potentially learn some science topics.

This study, therefore, aimed to determine the science education needs of students with intellectual disabilities. The study is valuable in terms of identifying the need to

prepare education and training curricula, establish learning settings in line with the needs of individuals with intellectual disabilities, and help teachers and practitioners how to make the necessary arrangements. Indeed, the educational settings designed based on these considerations will make individuals feel a sense of belonging and more valued in these environments. Within its parameters, in this context, the study addressed the following question: "What are the science education needs of students with intellectual disabilities?"

## Methods

### Research Model

The study followed the case study research design based on the qualitative research approach to make an in-depth description of the needs of students with intellectual disabilities for science education and making assessments. A case study method involves an in-depth analysis of an event, activity, process, or person (Cresswell, 2013).

### Sample

The case study required an in-depth analysis of the intended research; thus, it used the purposive sampling method. Three (3) special education teachers (a female and two males) and one (1) male science teacher participated in the study. The teachers had at least seven years of experience. The observation part of the study involved one (1) special education school and two (2) secondary schools with special education classes located in the center of Erzurum province. The primary objective of studying different schools was to observe and identify needs in every possible educational environment where special education students can receive an education.

### Data Collection Tools

Considering the validity of data collection, the study preferred interviews and observation techniques, which are widely used in qualitative research. The study also utilized a semi-structured teacher interview form developed by the researcher and unstructured observations in the data collection process to make detailed in-class and out-of-class observations. The interview form contained 12 open-ended and short-answer questions to determine the need for science education. After preparing the interview questions, two experts in chemistry education carefully examined the interview questions. The researcher updated the required questions based on the expert opinions and performed the interview form for the teachers. The teachers provided written responses to the interview questions. Consent was obtained from participants.

### Data Analysis

The study used observation and interview data for content analysis, categorized under different themes, categories, and codes, and presented them in the result section (Table 1). Two experts jointly performed the tests to ensure the reliability of the data analysis. Accordingly, their analyses revealed over 80 percent of concordance. The study made a new configuration in the categories with differences and displayed the final analyses in the results section.

## Results

The study analyzed the needs of the education and teaching environment and the educational needs of the students through unstructured in-school and in-class observations and semi-structured interviews conducted with three special education teachers and one science teacher. Table 1 summarizes the findings obtained from these observations and interviews.

Table 1.
*Findings of Needs Analysis*

| Theme | Category | Code |
|---|---|---|
| Educational Environment Needs | Out-of-class Environment | Canteen, WC, corridor, classroom location, etc. |
| | Communication and interaction | Peers, teachers, and other staff, etc. |
| Teaching Needs | Material | Availability and accessibility of material, etc. |
| | Teacher | Communication, method, attitude, reinforcement, etc. |
| Learning Environment Needs | Items in the classroom | The properties of the items, height, shape, etc. |
| | Physical Environment | Location and position of items, location of materials, etc. |
| Learning Needs | Science Learning | Learning science topics and concepts. |

As shown in Table 1, the analyses revealed four themes: educational environment needs, teaching needs, learning environment needs, and learning needs. Subsequently, the study determined the categories and codes for each theme and revealed the needs accordingly.

**Findings of Educational Environment Analysis**

Regarding the educational environment needs, the analyses identified the deficiencies related to out-of-class environments, communication, and interaction with peers and school personnel, in addition to the needs in areas such as the location of the classroom and the canteen. These findings are given below.

***Out-of-class Environments***

The educational environment is not only limited to the classroom but also involves in-school and out-of-school environments where students are out of classes and constitute the components of the education system. There was no essential equipment in the schoolyard, which is a critical place where students with intellectual disabilities can readily engage and communicate with their peers without disabilities. Thus, students with intellectual disabilities were unable to leave the classroom during break times and could not engage with their peers without disabilities. Additionally, the canteens, key locations that contribute to students' socialization, inclusion in daily life, and independence in meeting their needs, lacked the necessary arrangements. As a result, students with intellectual disabilities primarily relied on the meals (foods) they bring from home to meet their needs.

There were no essential arrangements inside the schools selected for the current study. Accordingly, the classrooms in both secondary schools were on the second floor, the staircases had no special arrangments, and there were no accessible walkways or elevators for students with intellectual disabilities. Additionally, the windows lacked an iron barrier, which would pose a risk when these individuals were alone in the classrooms. Finally, the disabled pathways outside the school were not empty and clean (vehicles, objects, snow, or other obstructions).

*Communication and interactive relation*

The non-disabled peers of the students, with whom they share their educational environments, communicate, and engage, were unaware and had insufficient knowledge of how to behave towards individuals with disabilities and how to assist them. Additionally, intellectually disabled students might be exposed to violence and similar misbehaviors by non-disabled students. The teachers at the school had observably insufficient knowledge about disabled students. Correspondingly, the cafeteria staff and other school employees lacked how to communicate with these individuals and how to behave towards them.

**Findings of the Teaching Needs Analysis**

One of the significant findings of the study was the scarcity of materials used in education and training or the difficulty of accessing them. The findings are summarized below.

***Material***

The educational settings where students with intellectual disabilities are taught lack sufficient educational and instructive materials. Teachers of special education students also lack the educational resources to make abstract concepts as concrete as possible in their education and encourage them to comprehend materials by seeing and touching them personally. Teacher #1 stated that *they exclusively experience material deficiencies and that the material design should be appropriate for teaching and improving teaching effectiveness*. In this context, teacher #1 indicated that *a shortage of materials and unsuitable settings adversely affect the education and teaching activities, limiting his capacity to execute the desired activities*. He additionally remarked that *the story cards, in particular, contain an intricate event pattern, and the cards related to the teaching topic are not properly prepared to describe ground-figure relations*.

Accordingly, the data findings regarding the material preparation and use based on in-class observations are as follows.

- Students should easily access smart cards, pictures, and real materials brought into the classroom environment for teaching for a set amount of time so that they can analyze them. Students should be able to examine and familiarize themselves with these materials.
- The design of the teaching materials should attract the attention and interest of the students to execute the activities desired. In this sense, the material itself or its picture displayed in the classroom should be visually well prepared. Indeed, the researcher observed that such materials were not designed and displayed properly.
- Student's disability level and type are critical issues to consider while preparing the educational material. For instance, if there is a student with low vision in the classroom, there should be worksheets prepared in large fonts, magnified visuals, and audio recordings to teach the course. Hence, this setting will ensure that the student will actively and effectively participate in the class.
- It is important to use course materials carefully, choosing items that students are familiar with, will encounter regularly, and utilize in their everyday lives to enable them to focus their attention on the course subject rather than the material.
- The size of the picture materials used in teaching critically affects students' learning. For instance, pictures that are at least 10x10 cm will have a

facilitating effect on the student's perception. The continually used picture cards should be glued onto hard cardboard and covered with PVC to prevent them from easy wear and tear.

***Teacher***

For special education teachers, it is essential to identify the deficiencies in terms of the effectiveness of teaching in the process and align them with the interests and needs of children with intellectual disabilities before and during the teaching process. Indeed, the teacher is an essential component of the teaching process. The issues outlined below are the findings based on in-class observations and interviews. As a result, special education teachers should pay utmost attention to these issues to meet the teaching needs while also ensuring the efficacy and success of the teaching process.

- Teachers must use clear, comprehensible language in the classroom without offending the students.
- Teachers must always exchange their views with school counselors, Provincial Guidance Research Centers, and special experts while identifying the interests and needs of the students, determining and using the methods and strategies they will implement in the classroom, and making potential adaptations in the classroom environment. Taking these issues into consideration will make education more effective.
- While teaching such individuals, teachers should not move on to another course topic or concept without teaching a topic or concept thoroughly. Otherwise, these individuals will fail to structure their knowledge and actualize an effective learning process.
- Beware of overdoing while giving concrete reinforcements to the students; instead, teachers should provide reinforcements in line with their interests and needs after determining them. Giving a reward that the student does not need would not serve as reinforcement.
- The course subject or unit should be made suitable for teaching by taking into account the purpose of the study and the characteristics of the student. Thus, a content analysis is necessary before teaching. With the content analysis, the content of the subject or unit should be recreated according to the mental level of the students.
- There should be a teaching plan developed for the course content.
- Teachers should pay utmost attention while planning the course and identify if there are students in the classroom with disabilities other than intellectual disabilities. If there is any such student, teachers should organize the teaching process by considering the disabilities of these students.

**Learning Environment**

***Materials in Classroom***

The observations made in the classroom environment resulted in unnecessary overstimulating items in the environment, an environment that was not simple enough, sharp corners of the inner and outer walls, doors, desks, blackboards, storage cabinets, coffee tables, etc. of the school, an unrounded classroom shape that might injure students, and uncarpeted floors lacking non-slip and sound-reducing carpets, etc., among other materials. Similarly, the desks, blackboards, storage cabinets, coffee tables, etc. were not fixed to the walls and floors to prevent students from falling on them and getting injured.

***Physical Environment***

The physical environment is one of the primary aspects of the arrangement of the educational setting. In this sense, the illumination design in the classroom was not in the form of avoiding distraction. The configuration, position, and height of student desks, teachers's desks, and blackboards were unadjustable. Electrical outlets were potentially dangerous for students and observably had no cover, or their locations were easily accessible by the students. Additionally, there were cutting and piercing tools such as scissors, knives, etc. carelessly kept open in areas where students could reach and inconsiderably accessible in secured cabinets. Students could readily reach these tools during breaks in the absence of teachers. Teacher #1 stated that *he could not always be with them since he was the only teacher in the classroom. He also indicated that students were left alone when they needed to take breaks and meet their special requirements, and eventually, some problems might arise during these times*. Briefly, teachers did not pay enough attention to arrange the educational setting in a way that develops the students' sense of belonging to the environment, makes them feel valued, and is minimally restricted. As a result, the arrangement of the classroom environment appeared to be without considering the individual competencies of students with intellectual disabilities and ignoring their self-confidence development.

**Findings of Learning Needs Analysis**

The study analyzed the science learning needs through semi-structured interviews with teachers and interviews conducted in schools and classrooms. Accordingly, teacher #2 stated that *students ought to learn some course subjects, such as solid-liquid-gaseous matters, certain disciplines included in the existing curriculum*. He

emphasized that *students with intellectual disabilities could also learn these topics if their content is prepared according to their level and supported with proper materials in the classroom*. Reiteratedly, special education teacher #2 underlined that *these individuals could learn certain science subjects*.

Considering the learning needs, special education teacher #1 stated that *choosing concrete course subjects is necessary for classroom discussions, and teaching should mainly involve laboratories*. As a result, special education settings must include laboratories for this purpose. Regarding the study about teaching some science-related subjects, teacher #1 also expressed that *students were very eager to learn the course subjects; they repeatedly asked him when they would study these topics again, and they were happy and enjoyed learning these science subjects*.
In summary, a school and classroom environment arranged in line with the science education findings presented in this result section will not only improve the effectiveness of science education but also help these students succeed academically in other courses and make progress in areas, including social skills and self-care.

**Discussion, Conclusion, and Recommendations**

This study aimed to determine the science teaching needs of individuals with intellectual disabilities. In line with the study findings, students' needs were categorized under the following four themes: educational environment needs, teaching needs, learning environment needs, and learning needs. The existence of the educational setting is the primary need. The study findings revealed that individuals with intellectual disabilities were unable to receive the necessary and satisfactory education. Furthermore, the content, objectives, teaching process, and evaluation process of education were not arranged based on the level and disability types of the students. Giving the necessary priority to educate such individuals is critical for them to survive independently in society and partake in daily life more successfully. The rights to education of individuals with special needs and their right to benefit from the educational services they are entitled to at the highest level are ensured by laws (National Education Fundamental Law No. 1739) and other legally binding statutory decrees (SD No. 573).

Regarding the need for science education and teaching, the special education teacher stated that the current curriculum involved the need for students to learn certain subjects, such as solid-liquid-gaseous matters. However, he explicitly underlined that the content of the course subjects should be adaptable to students' levels. Additionally, proper materials should support the lecture to provide an effective subject and content for science education. Studies in the literature also support this teacher's perspective as well. For instance, Mete (2016) taught some hard-soft matters to three students with intellectual disabilities and observed that two out of three students permanently learned the topic with the direct teaching method. Additionally, these two students were successful at the recall. The third student, on the other hand, failed to achieve permanent learning.

Based on the educational environment observations and interviews, the study revealed that the classroom and school environment were insufficient and unsuitable for teaching science to individuals with intellectual disabilities. A teacher pointed out numerous material deficiencies, indicating that the teaching materials should be proper and available in a manner that will increase the effectiveness of the teaching. Furthermore, he expressed that the lack of materials and improper educational environment would adversely affect teaching activities; thus, it would restrict his ability to provide desirable lecturing. As a result, the least restricted arrangement is best for educational settings (Çıkılı, 2013). In addition to effective education, the least restrictive educational environments will substantially affect the abilities of these individuals, establish and facilitate interactive relations and communication with their peers, and enable them to engage and develop friendships (Avcılar, 2010). Therefore, teachers should focus on arranging educational environments in a way that would develop students' sense of belonging to the environment and make them feel valuable (MEB, 2008; Tekinarslan, 2017). Another element to improve the effectiveness of education is to determine the educational needs and eliminate the deficiencies. Being aware of the needs and special cases of the students is critical for a successful education since designing an engaging and distraction-free educational environment is essential for increasing and sustaining the quality of teaching (Erişti et al., 2013). As a result, student behavior will directly benefit from a classroom environment that is structured with these factors in mind (Avcılar, 2010).

Individuals with special needs may also experience difficulties such as rejection and exposure to violence and similar misbehaviors by their peers. The success of these individuals, especially in inclusive practices, considerably relies on their ability to communicate effectively with their non-disabled peers and develop positive relationships and social acceptance. Environments, designed based on the mentioned issues, will positively contribute to students' active participation in daily life, their societal acceptance,

and the development of various aspects (Metin, 2012; Tekinarslan, 2017).

The study observations and interviews revealed that high-quality science teaching should meet certain requirements. The special education teacher also stated that science teaching should involve concrete subjects and underlined the significance of laboratories by expressing that laboratories are vital in special education environments. These findings are compatible with the research done with teachers from diverse branches (Balbağ & Karaer, 2016; Çınar, 2013; Demir et al., 2011; Geçer & Özel, 2012). Students' ability to learn effectively depends on opportunities that provide comprehensive and error-free learning. Erdem (2011) and Türer (2010) stated that developing a learning environment that will meet learning needs and provide the necessary opportunities will increase the success of students with intellectual disabilities. Correspondingly, Kasapoğlu, Duban, and Yüksel (2014) noted that student success will improve in properly organized educational environments.

The study findings revealed that a positive learning environment is necessary to improve educational quality. Hence, teachers are responsible for preparing learning environments based on student characteristics, needs, and the activities performed. Teachers should expectedly arrange materials to keep students engaged in the lesson, prepare the materials properly by considering the type and severity of student disability, and select the materials relevant to the subject matter and concept being taught, using materials that students come across and utilize frequently in their daily lives. Additionally, for the teaching to be effective and successful, teachers should use simple, clear, and comprehendible language without offending students, not overdo it while providing reinforcers, and give reinforcers accordingly by specifying the interests and needs of the students. They should also replan the subject and concept contents based on the intellectual level of the students, generate a content-related teaching plan in this direction, and avoid moving on to another subject or concept before teaching the previous one completely. In this context, Geçer and Özel (2012) reported that the lack of proper arrangement of physical environments and the absence or deficiency of teaching-related materials and equipment available cause teachers to experience difficulty performing activities in science and technology classes.

In light of the findings, this study underlines the following recommendations to meet the needs for science education provided to students with intellectual disabilities;

- Individuals with intellectual disabilities can learn certain daily life-related science course subjects in the presence of the necessary arrangements. Hence, it is possible to teach particular science course subjects to such individuals by determining the science-related subject they can learn and providing suitable settings for science applications in both special education classes and other educational environments.
- The materials used for individuals with special needs are of utmost significance since they pose diverse characteristics. Education and teaching materials developed based on each student's deficiencies will increase academic success. Hence, it is necessary to design materials that serve the individual characteristics of each student in science teaching.
- One of the key requirements that must be met in educational environments is to ensure the suitableness of an education and training environment. However, this study identified that the places of special lower divisions (masses) were unsuitable in schools, some in-school and out-of-school areas were insufficient in providing education and training for intellectually disabled individuals, and the security of these classes was insufficient enough for such individuals. Therefore, it is vital to determine the deficiencies and conduct studies to take the necessary measures by controlling the suitableness of in-school and out-of-school environments for individuals with special needs and providing the proper security conditions in educational environments for special education.

**Ethics Committee Approval:** According to the decisions of the Council of Higher Education in Turkey, ethics committee approval was not required for retrospective studies conducted before 2020.
**Informed Consent:** Consent was obtained from participants.
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