SINIRSIZ EĞİTİM VE ARAŞTIRMA DERNEĞİ

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The Journal of Limitless Education and Research, Volume 10, Issue 2

Sınırsız Eğitim ve Araştırma Dergisi, Cilt 10, Sayı 2

Dear Readers,

We are delighted to present you the July 2025 issue of the Journal of Limitless Education and Research.

The aim of our journal, the Limitless Education and Research Association (LERA), has continuously been published since 2016 is to contribute to the field of education and research with new scientific studies. To this end, theoretical and experimental original research, review articles, thesis summaries, and other scientific works are published for free and shared with readers at both nationwide and worldwide.

The Journal of Limitless Education and Research (J-LER) is published three times a year in both Turkish and English. As an international peer-reviewed journal, it is prepared with the scientific endeavors, contributions, and support of academics, scholars, researchers, educators, and teachers from different countries. Each issue including current and new studies is meticulously presented to the readers in the field, following thorough reviews.

Maintaining its academic and scientific quality for ten (10) years, the Journal of Limitless Education and Research (J-LER) is indexed in the EBSCO, Education Full Text (H.W. Wilson) Database Coverage List, which is recognized by the Council of Higher Education (ÜAK). It is also indexed in various national and international databases such as ASOS, DRJI, ESJI, OAJI, ROAD, SIS, SOBİAD, and Worldcat, and receives a significant number of citations. According to the SOBİAD impact factor, our journal ranks highly among scientific journals in our country. Efforts to have our journal indexed in more extensive national and international databases are ongoing.

In the July 2025 issue of our journal, eight (8) scientific research and review articles are featured. We would like to thank all the editors, authors, reviewers, and translators who contributed to the preparation and publication of this issue. With the hope that our journal will bring contributions to scientists, researchers, educators, teachers, and students in the field, we extend our best regards.

LIMITLESS EDUCATION AND RESEARCH ASSOCIATION

The Journal of Limitless Education and Research, Volume 10, Issue 2

Sınırsız Eğitim ve Araştırma Dergisi, Cilt 10, Sayı 2

Değerli Okuyucular,

Sizlere Dergimizin Temmuz 2025 sayısını sunmaktan büyük mutluluk duyuyoruz.

Sınırsız Eğitim ve Araştırma Derneği (SEAD) tarafından 2016 yılından bu yana 10 yıldır kesintisiz olarak yayınlanan Dergimizin amacı, yeni bilimsel çalışmalarla eğitim ve araştırma alanına katkı sağlamaktır. Bu amaçla kuramsal ve deneysel özgün araştırmalar, derleme makaleler, tez özetleri ve diğer bilimsel çalışmalar ücretsiz yayınlanmakta, ulusal ve uluslararası düzeydeki okuyucularla paylaşılmaktadır.

Sınırsız Eğitim ve Araştırma Dergisi (SEAD), yılda üç sayı olarak Türkçe ve İngilizce yayınlanmaktadır. Uluslararası hakemli dergi olarak farklı ülkelerdeki akademisyen, bilim insanı, araştırmacı, eğitimci ve öğretmen yazarların bilimsel çaba, katkı ve destekleriyle hazırlanmaktadır. Her sayıda titiz incelemeler sonucu güncel ve yeni çalışmalar alandaki okuyuculara sunulmaktadır.

Akademik ve bilimsel kalitesinden ödün vermeden on (10) yıldır yayın hayatını sürdüren Sınırsız Eğitim ve Araştırma Dergisi (SEAD), ÜAK tarafından alan indeksi olarak kabul edilen EBSCO, Education Full Text (H.W. Wilson) Database Covarage List'te taranmaktadır. Ayrıca ASOS, DRJI, ESJI, OAJI, ROAD, SIS, SOBİAD, Worldcat gibi ulusal ve uluslararası çeşitli indekslerde taranmakta ve çok sayıda atıf almaktadır. SOBİAD etki faktörüne göre Dergimiz, ülkemizdeki bilimsel dergiler içinde önemli bir sırada bulunmaktadır. Dergimizin daha geniş ulusal ve uluslararası indekslerde taranması için girişim ve çalışmalarımız devam etmektedir.

Dergimizin Temmuz 2025 sayısında sekiz (8) bilimsel araştırma ve derleme makaleye yer verilmiştir. Bu sayının hazırlanması ve yayınlanmasında emeği geçen bütün editör, yazar, hakem ve çevirmenlere teşekkür ediyoruz. Dergimizin alandaki bilim insanı, araştırmacı, eğitimci, öğretmen ve öğrencilere katkılar getirmesi dileğiyle, saygılar sunuyoruz. Dergimizin alandaki bilim insanı, araştırmacı, eğitimci, öğretmen ve öğrencilere katkılar getirmesi dileğiyle saygılar sunuyoruz.

SINIRSIZ EĞİTİM VE ARAŞTIRMA DERGİSİ

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Use of Assistive Technology in Visual Impairment: A Systematic Review

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Abstract: With the development of technology in recent years, assistive technologies are one of the important issues emphasized in the field of special education. Assistive technologies, whose main purpose is to enable individuals with disabilities to gain independence and make sense of information, are widely used in the education of individuals with visual impairment. This study was conducted as a systematic review to examine the articles published on the use of assistive technology in visual impairment. In this context, studies published in the national and international literature between 2020-2024 on assistive technologies used in the education of individuals with visual impairment were examined within the scope of the inclusion and exclusion criteria. Within the scope of the study, the research data obtained through systematic review were analyzed using the descriptive analysis method. In the systematic search, 14 different studies were reached by using Google Scholar, Science Direct, Bursa Uludağ University Library, and DergiPark databases. Research shows that mobile and web-based applications used in the education of individuals with visual impairment, assistive technologies containing high-level technology, provide individual-specific learning experiences, support the education of individuals with visual impairment, and positively affect the lives of individuals.

Keywords: Special education, Visual impairment, Educational technology, Assistive technology, Systematic review.

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1. Introduction

Our sense of sight, which is one of the sense organs that contribute to the perception and interpretation of stimuli from the environment, is very important for learning activities. In other words, our sense of sight mediates our gathering of information from the environment and contributes to our learning activities. It is possible to talk about visual impairment if the visual level of an individual is below the normal level. Visual impairment is defined as damage to the structure of the eye due to various reasons and this situation prevents the eye from performing its functions (Tuncer, 2003). Visual impairment, which is defined as a person's visual ability being lower than the normal level, can significantly affect an individual's daily life activities. Visual impairment covers a wide range from complete blindness to mild visual impairments. Studies on the causes of visual impairment and the effects of this impairment on the individual show that this impairment can be caused by many biological, environmental, and genetic factors. The World Health Organization (WHO) classifies visual impairment according to certain criteria. By evaluating visual acuity and visual field, WHO defines normal vision, mild visual impairment, severe visual impairment, and blindness. These classifications play an important role in determining the possible difficulties that the individual may encounter in daily life and the areas of support they may need (WHO, 2022). Visual impairment can significantly affect the quality of life of individuals in many areas. In particular, loss of independence in daily activities, limitation of education, and job opportunities are among the main challenges that individuals with visual impairment may face.

The sense of sight plays a fundamental role in learning and this idea is supported by many scientific studies. Over time, various studies have been conducted on the effect of vision on learning. According to different studies investigating the effect of the sense of sight on learning, it is estimated that 80-85% of the information acquired during learning activities is obtained through the sense of sight (Ataman, 2012). In this respect, when the effect of the sense of sight on learning with the rich sensations it provides is evaluated, it can be said that the sense of sight stands out from other sense organs (Ataman, 2003). Considering this importance, it can be said that in cases where the sense of sight is damaged, deficiencies in learning can be observed. It can be said that the sense of sight has different effects on learning experiences. These include information processing, memory, attention, and motivation. Visual information is quickly processed and understood by our brains. According to Mayer and Moreno (2003), visual information, especially pictures and diagrams, is highly effective in learning. Visual materials facilitate learning by making abstract concepts concrete and easier to understand. Visual

information provides more permanent learning by leaving a trace in the memory. Paivio (1986) argues that the combination of visual and verbal information results in more effective learning. Learning results are better when the two types of information are processed together. While the sense of sight is so important for education, it is necessary to mention the difficulties experienced by individuals with visual impairment in the field of education as in all areas of life.

Visual impairment is a complex health problem that negatively affects the lives of individuals and causes various difficulties. One of the most problematic areas for individuals with visual impairment is education. Education enables individuals to actively participate in social life and improves their social skills. Some of the problems faced by individuals with visual impairment who encounter many problems in the educational environment can be listed as access to course materials, restriction in independent movement in the classroom, and limitations in communication with peers. It is of great importance to provide appropriate support and services for students with visual impairment to overcome the difficulties they face in their educational processes. These supports help individuals to be more independent and successful in education and beyond. These difficulties may negatively affect the academic achievement and social skills of students with visual impairment. Numerous strategies and technological tools are used to improve the quality of life of individuals with visual impairment and to enable their participation in society. The use of assistive technologies can significantly overcome the difficulties encountered in many areas. Assistive technologies not only help the education of individuals with visual impairment but also support their independent living skills. There are research findings that the inclusion of assistive technologies in the education of individuals with visual impairment provides benefits for the development of independent learning and problem-solving skills (Doleanu & Hutuleac, 2023). Before addressing the benefits of assistive technologies for individuals with visual impairment, it is necessary to address the benefits of technology for education.

Technology, which we utilize at many points in our daily lives, has become an indispensable element of educational environments. The use of technology in the educational environment aims to improve the quality of the educational environment and learning activities (Ghory & Ghafory, 2021). It is possible to come across many studies in the literature on the benefits of educational technologies to learning if they are used correctly. The effective use of educational technologies in educational environments enables students' learning skills, problem-solving skills, and effective participation in the lesson (Khan & Emara, 2018). This can be reinforced by a previous study conducted with pre-service teachers (Sadi et al., 2010) in which

pre-service teachers stated that technology provides retention in learning, improves the quality of the lesson, and increases students' motivation in lessons. A more recent study by Akintayo et al. (2024) found that in addition to increasing class participation, educational technologies contribute in different areas such as improving the retention of knowledge and promoting higher-order thinking skills. The use of technology in education not only concretizes what is learned and makes it permanent, but also makes teaching activities fun. In this way, participation in teaching activities also increases. It can be said that the use of technology in education provides an interactive learning environment and rapid transfer of information by increasing student motivation. Technology makes a significant contribution to the development of students' cognitive skills by providing quick access to many resources. Teachers can make use of technology according to the needs of their students and customize student experiences. In addition to attracting students' attention, technology-based education positively affects learning outcomes by providing flexible learning opportunities and accordingly increases academic achievement, retention of knowledge, critical thinking skills, participation, motivation, and interaction and communication between teacher and student (Malik, 2023; Mack & Houchens, 2023). Celep and Tülübaş (2014) state that teachers' positive attitudes towards educational technologies play a very important role in the effective integration of these technologies into teaching and learning processes. While the role of teachers is so important in terms of the use and positive outcomes of educational technologies, special education teachers are of course among the important stakeholders of this responsibility.

Assistive technologies increase the independence and safety of the individual and promote their inclusion in society by improving their quality of life (Hakobyan et al., 2013; Ghafoor, 2023). At the same time, studies with assistive technologies show that they facilitate the social interactions of individuals with visual impairment (Karimi, 2024; Ghafoor, 2023); applications designed to assist in reading also have the potential to significantly improve the quality of life of these individuals (Walker et al., 2016); they support their independent participation in educational environments (Manirajee et al., 2024). When the literature is examined, it is seen that assistive technologies support the strengths of individuals with visual impairment and contribute to the development of these aspects, and contribute significantly to their academic success (Sidiqua, 2022). Based on these findings, we can say that assistive technologies facilitate the learning processes of visually impaired individuals when applied appropriately in educational environments and provide equality and accessibility in education (Wong, 2018). However, in order to use these technologies effectively, in addition to the

inequalities in equipment and education (Alananbeh & Asha, 2023), it is necessary to keep in mind the importance of educational technologists and expertise in this field, and the fact that instructors should have the skills to use assistive technologies effectively (Zhou et al., 2011; Siu & Morash, 2014). Xia et al. (2023) emphasized that special education teachers should have professional skills in educational technologies to improve the quality of teaching and facilitate the adaptation of students with special needs to school and society. Although this responsibility seems to be largely on teachers, for the effective use of educational technologies, institutions need to develop a vision and plan for the integration of these technologies into teacher education programs to ensure their effective use in classrooms (Strudler & Wetzel, 1999).

Students with disabilities have problems in achieving the goals set in general education programs and therefore need various support and instructional adaptations to acquire target skills (Kargın, 2007). In this context, as mentioned above, it is very important to use technology in special education in order to minimize the problems experienced by students with special needs in their education, to make instructional adaptations, and to provide rich learning environments for individuals. For this reason, Individualized Education Programs (IEP) are issues that should be prioritized in the field of education in order for students to benefit from the education they receive at a high level. So what is IEP? IEPs are individual education plans designed to meet the special needs of each student. Focusing on the student's strengths, weaknesses, and educational goals, the IEP provides the necessary support and resources to ensure that students with visual impairment are successful in education. With regard to students with visual impairment, the development and implementation of an IEP plays a crucial role in ensuring that these students receive educational support appropriate to their individual needs. In his study, Chase (2022) mentioned the importance of the core curriculum for students with visual impairment and emphasized that this program should be included in IEPs. It is known that students with visual impairments not only need special materials such as Braille or large print characters to improve their reading and writing skills (Spungin, 2002) but also have difficulty actively participating in learning activities. It has been observed that they have difficulty, especially in courses based on visual information such as math and science. For example, Koehler and Wild (2019) addressed science education in their study and stated that students with visual impairment have difficulties in participation because science lessons are very visually oriented. In the education of students with visual impairment, the inclusion of auditory stimuli and the use of assistive technologies will lead to more effective results in students' learning.

When we put together what has been explained up to this point, we can say that the loss of the sense of sight directly affects the individual's learning as well as his/her daily life. Individuals with visual impairment have direct difficulties in accessing information. Therefore, the main purpose of utilizing assistive technologies for visual impairment is to provide access to information for the individual with visual impairment. Based on other studies in the literature, we can define that the main purpose of assistive technologies is to ensure the independence of individuals with visual impairment and to help them make sense of information. Assistive technologies developed for individuals with visual impairment include tactile and auditory-based materials designed in addition to visual materials to provide an effective learning experience. Since these individuals cannot benefit from their sense of sight for learning purposes, we can say that they need more tactile and auditory materials during teaching activities (Bahşi & Sis, 2023). The fact that the benefits of assistive technologies used in visual impairment are not limited to the educational environment was among the issues mentioned earlier. In this sense, assistive technologies can have an incentive effect by encouraging individuals with disabilities to interact with others and overcome their fear of social isolation (Hakobyan et al., 2013).

In special education, assistive technologies are used for various reasons such as individualizing teaching, supporting the individual, and making learning permanent. Although only computers usually come to mind when the concept of assistive technology is mentioned, assistive technology devices cover much more than that and have a long history in the field of special education (Edyburn, 2000). Assistive technologies can be all kinds of tools and equipment used to sustain and facilitate the lives of individuals with special needs. The assistive technologies used increase the quality of life of individuals with special needs, reduce their dependence on someone, and help them reach the targeted skills. Ensuring that individuals with special needs fully benefit from assistive technologies is a necessity not only for educational environments but also for their independence at home and in social life (Alper & Raharinirina, 2006). Identifying and providing appropriate support services and assistive technologies for the full participation of individuals with special needs in learning activities and efficient learning outcomes is critical for the successful realization of educational activities. Researchers (Cavanaugh, 2002; Johnston et al., 2007; Çakmak et al., 2016) categorize assistive technologies into three categories: high-level, medium-level, and low-level assistive technologies. High-level assistive technologies have a more complex structure, are usually computer and internet-based, and require training for their use, while low-level assistive technologies include simple and low-

cost materials that are more readily available. Medium assistive technologies are less costly and more practical to use than high assistive technologies. A computer application reading a book is an example of a high-level assistive technology, while an individual reading a book with the help of a magnifying glass is an example of a low-level assistive technology (Cavanaugh, 2002). Assistive technologies, which have costs ranging from low to high, increase the quality of life of individuals with visual impairment while supporting their independent living skills, and also help with reading and communication (Yadav et al., 2023). For example, some of the assistive technologies traditionally used to eliminate the difficulties faced by individuals with visual impairment in education are Braille displays, screen readers, and magnifiers (Irvine et al., 2014). However, with advancing technology, high-tech devices such as smartphones, tablets, and computers have emerged as valuable tools for people with visual impairments and include built-in accessibility features that can potentially replace traditional visual aids (Martiniello et al., 2019). Smart canes and devices that translate speech into written text increase the independence of individuals with visual impairment in daily life (Khan & Khusro, 2021).

Braille displays are assistive technology tools that enable individuals with visual impairments to interact with computers and read the presented texts in Braille. These devices create embossed dots, allowing texts to be read in Braille format. Beal and Rosenblum (2018) stated that the development and use of assistive technologies such as screen readers, Braille displays, and audio devices provide students with visual impairments with an accessible education and support their independence in daily life. Screen readers, another assistive technology, facilitate access to information for individuals with visual impairments by reading the texts on the computer screen aloud. Screen reader texts provide convenience to users by reading the text that appears on the screen aloud. JAWS and NVDA are the most widely used screen readers. Tablets and smartphones, which are among the higher-level assistive technologies, are among the devices commonly used by individuals with visual impairment. These high-tech devices have features that increase accessibility such as screen magnification and recognition of voice commands. There are also many downloadable educational applications on these devices. It is possible to install various applications that will increase accessibility according to individual needs. Screen reader software such as VoiceOver and TalkBack are widely used on smartphones. Smartphones have an important role in supporting the education and independent living skills of individuals with visual impairment (Tan et al., 2024).

With the development of technology every day, the effect of new assistive technologies on the learning of individuals with visual impairment is being tested and the use of assistive technologies is increasing. Considering the advantages that assistive technologies provide to individuals, it can be said that with the developing technology, researchers can develop new materials and applications for the education of individuals with visual impairment. From this point of view, this study aims to compile the assistive technologies used in the education of individuals with visual impairment in recent years and to guide researchers working in this field.

2. Method

This study was conducted as a systematic review to examine the articles published on the use of assistive technology in visual impairment. In systematic reviews, it is aimed to conduct scans on a determined subject, taking into account the predetermined inclusion and exclusion criteria, and synthesize and present the findings (Karaçam, 2013; Grove et al., 2015; Zawacki-Richter et al., 2020). Systematic review studies are a research method developed to review previous studies on a specified topic and to compile and summarize the studies (Gökdemir & Dolgun, 2020).

2.1. Systematic Review Process

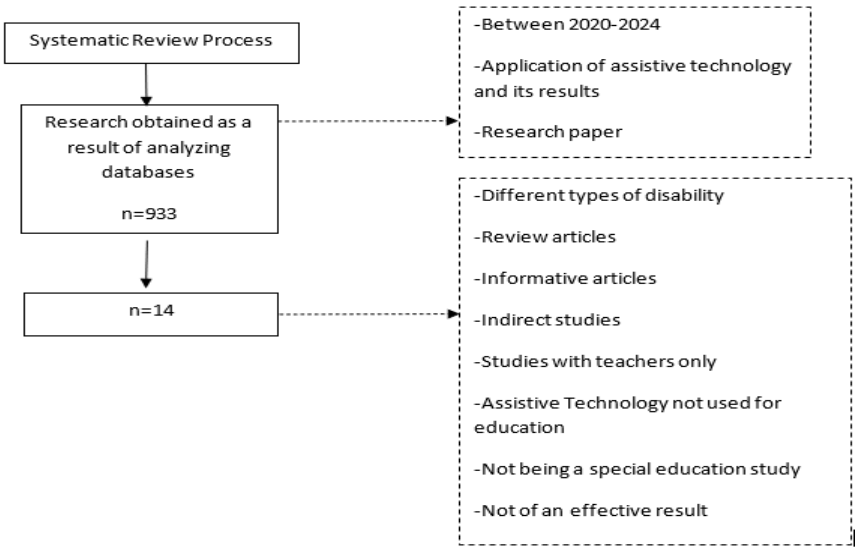

Figure 1. Systematic review process

The scientific studies examined within the scope of this research were accessed through Google Scholar, Science Direct, Bursa Uludağ University Library, and DergiPark databases. The selected articles were evaluated within the scope of inclusion and exclusion criteria.

Keywords were searched in the databases to access the studies included in the review. In this context, the keywords “Special Education”, “Visual Impairment”, “Blind” and “Assistive Technology” were searched to access national studies. As a result of searching Turkish keywords, 41 studies were reached. To access international studies, the keywords “Special Education”, “Special Education Technology”, “Visually Impaired”, “Blind” and “Assistive Technology” were searched in the databases. As a result of searching English keywords, 892 studies were reached.

Within the scope of the study, articles whose full text could be accessed were used. National and international publications between 2020-2024 were included in the study. Within the scope of the study, studies examining the effects of assistive technologies on education and training were included in the review. Considering the developing technology, studies published in the last 5 years were included in the review, as it is thought that more up-to-date and high-level assistive technologies can be accessed. In the studies to be selected, the feature of being a research article was sought and attention was paid to include results about an assistive technology used and its effects. When the year filter and other inclusion criteria were applied, 22 Turkish and 356 English studies were found.

Exclusion criteria were added to these studies; (a) the presence of a disability in addition to visual impairment, (b) being a review article, (c) being an informative article, (d) being an indirect study, (e) being studies conducted only with teachers, (f) not using assistive technology in the dimension of education, (g) not being a special education study, (h) not sharing the effective result. As a result of these exclusion criteria, a total of 14 articles were included in the review. The 14 articles that met all the applied inclusion and exclusion criteria are tabulated with their colophons, participants, methods, and outcomes.

3. Results

Within the scope of the research, studies conducted between 2020-2024 on the use of assistive technology in visual impairment in national and international literature were examined, 14 studies that met the inclusion/exclusion criteria were examined and the findings obtained were tabulated which can be seen in Table 1.

Table 1
Distribution of the studies according to research approach

Author	Year	Participants	Method	Assistive Technology	Output
Matoušek et al.	2020	A total of 41 middle school students in sixth, seventh and eighth grades between the ages of 12 and 14; 14 girls and 27 boys	Experimental Research	A new TTS (text-to-speech) interface	Positive
Marpaung et al.	2022	A high school student with visual impairment from a state in Malaysia	Mixed Research Design	JAWS, MELDİCT	Positive
Hamid & Setiawan	2022	A visually impaired student in her 4th semester at a private university in South Sulawesi, Indonesia	Qualitative Case Study	JAWS, MELDICT	Positive
Kamali Arslantas et al.	2021	In the first group, 15 participants were 7th and 8th grade students; in the second group, participants are experts	Mixed Research Design	Web-based exercise practice	Positive
Tipi et al.	2023	3 secondary school students in Ankara	Experimental Research	Tactile Images Reader mobile application (TIR) Touch-Sense-Learn model	Positive
Küçüközyiğit & Çakmak	2020	8-year-old student with visual impairment	Case Study	Turkish Active Keyboard Teaching Program (TEKÖP)	Positive
Bozdağ et al.	2022	30 students aged between 12-15	Case Study and Fieldwork	3D printing material	Positive
Ayaz et al.	2023	Four students with visual impairment whose ages are 10,13,13 and 23	Action Research	Mobile Application	Positive
Maćkowski et al.	2022	30 students between the ages of 16-22	Mixed research Design	Mathematics interface design	Positive
Saeedakhtar et al.	2024	22 male students with visual impairment at a high school in Tehran, Iran	Quasi-Experimental Research	NVDA software	Positive
Kızılaslan, et al.	2022	4 students with visual impairment studying at a state secondary school for the visually impaired	Design-Based Research	Tactile Material	Positive
Kızılaslan & Sözbilir	2022	6 students studying in the 8th grade of the Secondary School for the Visually Impaired	Design-Based Research Model	Tactile Material	Positive
Bahşi & Sis	2023	4 students studying at Battalgazi Middle School for the Visually Impaired in Malatya, Türkiye	Arbitrary Design with Only Posttest and Control Group	Digital Story	Positive
Yazıcı & Sözbilir	2020	15 students with visual impairment in grade 6th	Design-based Reaserch Model	Lesson activity with 3D models and various tactile materials	Positive

3.1. Distribution of Studies According to Their Purposes

When the articles included in the review are examined in terms of their purposes, they can be classified as: designing activities related to the use of assistive technology, the effects of assistive technologies in the education of students with visual impairment, the use of assistive technology in foreign language and mathematics teaching and developing assistive technologies that include high-level technology.

3.2. Distribution of the Studies According to the Years They were Conducted

As seen in Figure 2, 3 (21.4%) of the 14 articles that met the research criteria between 2020 and 2024 were conducted in 2020, 1 (7.1%) in 2021, 6 (42.9%) in 2022, 3 (21.4%) in 2023 and 1 (7.1%) in 2024. Since the number of studies in 2022 is higher than the others, it is seen that studies on the use of assistive technology in visual impairment are more preferred in 2022.

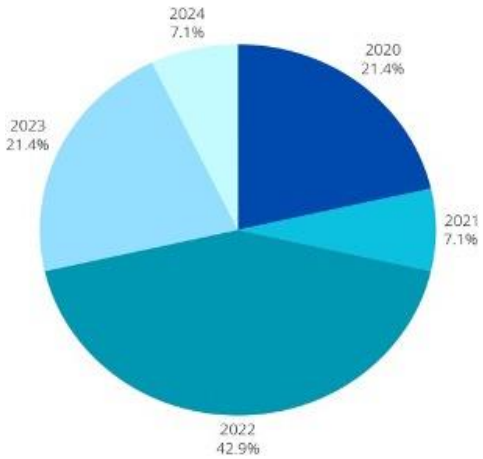

Figure 2. Distribution of the studies according to the years

3.3. Distribution of Studies According to Research Approaches

The research designs of the studies on the use of assistive technology in visual impairment were examined and the findings are presented in Table 2.

Table 2
Distribution of the studies according to the research approach

Research Type	f	%
Quantitative Research	4	28.57
Qualitative Research	4	28.57
Mixed Method	3	21.42
Design-Based Research	3	21.42

As seen in Table 2, 4 of the studies on the use of assistive technology in visual impairment were conducted with a quantitative research approach, 4 with a qualitative research approach, 3 with mixed methods, and 3 with a design-based research approach.

3.4. Distribution of Studies According to the Levels of Assistive Technology Used

Figure 3 shows the levels of assistive technologies used in the analyzed studies. Accordingly, 10 (71.4%) of the 14 studies used high-level assistive technology tools, while 4 (28.6%) of the studies used low-level assistive technology tools. Among the studies, studies using similar levels of assistive technology were found. Yazıcı and Sözbilir (2020) and Kızılaslan and Sözbilir (2022) conducted activities using tactile materials for students with visual impairment and low-level assistive technology in their studies. Similarly, Marpaung et al. (2022) and Hamid and Setiawan (2022) utilized JAWS and MELDICT applications that require higher-level technology in their studies with students with visual impairment.

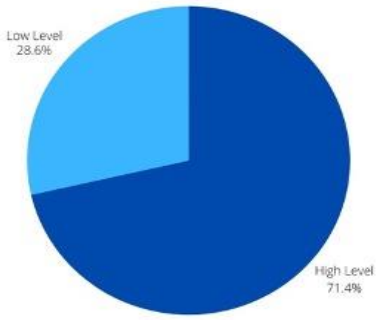

Figure 3. Distribution of the studies according to the levels of assistive technology used

3.5. Distribution of Studies According to Participant Levels

Table 3 shows the distribution of the studies according to participant level. Accordingly, most of the studies were conducted with middle school students (f=90, 50%) and mixed groups of different qualities (f=64, 35.55%). On the other hand, the number of studies conducted with high school students (f=24, 13.33%); primary school students (f=1, 0.55%), and university students (f=1, 0.55%) remained low compared to the studies with middle school and mixed participants. Within the framework of these findings, it can be said that more research is needed at the primary and high school levels.

Table 3
Distribution of the studies according to participant levels

Participant Level	Number of Studies	f
Primary School	1	1
Middle School	7	90
High School	2	24
University	1	1
Mixed	3	64

4. Discussion and Conclusion

It is seen that all 14 articles included in the systematic review within the determined criteria have positive outcomes. There are studies on different levels of assistive technologies with different levels of students.

When the studies are examined, it is seen that assistive technologies such as JAWS and MELDICT have positive effects on the learning outcomes of students with visual impairment. Researchers (Asha & Chelleppan, 2011) state that JAWS software is widely used and facilitates access to technology for students with visual impairment. Marpaung et al. (2022) used JAWS and MELDICT applications to improve the English skills of a student with visual impairment, and in the results of these applications, it was noted that the student's writing skills improved, and it was also observed that the student's creativity in the use of English vocabulary increased with the use of MELDICT. In addition to these results, the student was able to act more independently than before. It was concluded that teachers were lacking in the use of assistive technology and teachers should be trained in this regard. Hamid and Setiawan (2022) proved in their study that the use of JAWS and MELDICT increased the assimilation of educational materials by students with visual impairment and effective learning took place. These results are consistent with the results of the literature on the use of JAWS and MELDICT in English language teaching (Wiyanah, 2016; Susanto & Nanda, 2018) and the independent learning process (Kapperman et al., 2018).

In the education of individuals with visual impairment, arrangements such as Braille and font enlargement have been made from past to present, and with the development of technology, audiobooks have also taken their place in assistive technologies (Ataman, 2003). With the developing technology, applications such as Smart Cane (WeWalk), Braille Managers, Screen Reading Programs, Windows-eyes, Jaws, Smart Watches, Smart Guide Glasses, Smart Shoes, Voice Shopping with Beacon Technology have been included in the lives of individuals with visual impairment (Cifcibaşı Iyigün & Tortop, 2018). Assistive technologies developed at a higher level with the developing technology provide the needs of individuals with visual impairment, support their independent lives, and offer different alternatives in rapidly

developing areas such as education, communication, and communication. Cifcibaşı Iyigün & Tortop (2018) state that innovative technological tools will contribute positively to the life satisfaction of individuals with visual impairment. Considering all their contributions, assistive technologies should be given more space in educational environments. At this point, teachers should follow current studies, make adaptations for technological tools in teaching and participate in trainings on these issues.

As a result, in this study, a review of current assistive technologies used in the education of individuals with visual impairment has been created. For this reason, since it is aimed to show the reflection of the developing technology on the education of individuals with visual impairment and to reveal the current trend in the studies, the researches in the last 5 years have been compiled. As a result, it is thought that the review will provide an idea for researchers working in the field to test different technologies in the education of students with visual impairment or to make comparisons between technological applications.

CONFLICT OF INTEREST STATEMENT

The authors declare that there is no conflict of interest in this study.

RESEARCH AND PUBLICATION ETHICS STATEMENT

The authors declare that research and publication ethics are followed in this study.

AUTHOR LIABILITY STATEMENT

The authors declare that the “Conceptual Framework, Method Design, Research, Data Analysis and Software, Gathering Sources, Post Draft, Visualization, Project Management” part of this work was done by Mert Can KAYA, “Method Design, Data Analysis and Software, Gathering Sources, Review and Editing, Project Management” part of this work was done by Asist. Prof. Dr. Özge BOŞNAK.

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