Review Article

Use of assistive and adaptive technology in learning English as a foreign language: A systematic review

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ARTICLE INFO	ABSTRACT
	With the advancement of technologies, disabled students are being cared for to progress in their education through assistive technologies (AT). They ensure the inclusion of the target group to make them equal with their peers who do not suffer from disabilities. Unfortunately, there is only scarce research on this margin group in connection with technology. Therefore, the aim of the systematic review is to conduct research on the best practices, pedagogical implications, and limitations for the target group using AT. The results based on the review of empirical studies on the research topic conducted between 2013 and 2023 suggest that the best practices of AT are coming from recent years, specifically from 2017, and countries ranging from Europe to Indonesia and Thailand. Pedagogical implications suggest that the learners using AT are becoming more autonomous, independent and successful in academic achievements. Limitations within the study include the fact that AT needs to be more developed and accessible to learners along with more specialized training of specialists and teachers. Future research on the topic should be aimed at better equipment for these learners with AT. **Keywords:** assistive technology, assistive technology, learning, English as a foreign language, systematic review

INTRODUCTION

There is no doubt about the prevalence of technology in education these days for the current generation of students. To make sure all learners are included in education, assistive technologies (AT) come up to the front since they adjust and specialize learning technologies for the overlooked student population to ease their learning processes and make them equal learners. AT are characterized as "technology, devices, and other systems used by disabled and/or elderly people to overcome the social, infrastructural and other barriers to independence, full participation in society and carrying out activities safely and easily" (Hersh & Mouroutsou, 2015). AT includes computers with specialized software, digital hearing aids and glasses, and handheld magnifiers and canes (Khan, 2022). Additionally, Khan (2022) emphasizes that based on the recommendations of the United Nations every visually impaired learner has the same rights as their sighted counterparts and every member country should take measures in this regard. The overall aim is social inclusion and a better quality of life for this target group. This fact is also reflected in the study by the European project EN-ABILITIES (enabling inclusive education through technology), which proposes a comprehensive tool based on the principles of universal design for students with physical, hearing and visual impairments (VI). Furthermore, it seeks to improve language and communication skills among students with SEN and, consequently, seeks to expand opportunities for employability, participation in society, mobility and social inclusion (Arribas et al., 2020).

However, it seems that when it comes to foreign language learning, there are more studies on the use of AT among students with VI than any other impairments (Suriá Martínez, 2011) since AT help acquire content such as screen readers for blind people to access computer or dyslexic people provided with spell check and other writing programs (Hersh & Mouroutsou, 2015). Importantly, these margin groups of learners with VI are characterized as having varying degrees of vision loss from low vision to total blindness (Arslantas et al., 2019). According to Phichiensathien and Inspin (2021), VI students have a strong sense of hearing, memory, and visualization when learning English. Furthermore, they learn best by touch and sound. They are researched because they face several difficulties one is not aware of. Those include limited access to information and teachers' lack of knowledge connected to their inability to use AT, which contribute tremendously to the FL learning needs of VI people (Arslantas et al., 2019). Additionally, VI students are dependent on other people when using books with Braille and listening to audio media. Therefore, there comes the crucial challenge to equip these learners with instructional materials with the help of AT for VI people to provide them with more autonomous learning (Phichiensathien & Ipin, 2021). Studies so far in the Thai context have concentrated on material requirements for VI learners, not on highly needed vocabulary development for VI learners, where AT is needed for Braille codes, audio media, and 3D touch media (Phichiensathien & Ipin, 2021). Another study aimed at guaranteeing equal access to information, education, and employment, and most importantly reducing the digital divide through AT leading to easily-navigable and user-friendly e-learning environments is one done in Greece by Drigas et al. (2013) already. They proposed an e-learning environment for teaching disabled learners with visual and hearing defects. This environment stems from adaptation and feasible navigation through AT to their learning needs and stresses the importance of the combination of ICTs together with e-learning technologies to bring the effective implementation of the teaching methods of the target groups. The other findings come from Khan's (2022) study in Pakistan, where AT helps using the auditory and tactile senses of these learners and they rely less on their sighted peers. In addition, they access and complete study materials more effectively, which leads to their independence. It is supported by research in Oman by Siyaby et al. (2022) that AT supports autonomy, participation, academic standing, and success, and in general, it empowers learners, so they feel more confident and capable. However, the general problem is that this marginal group often has hesitations in using learning aids; there are issues with gadget performance, and stigmatization (Khan, 2022).

Therefore, the aim of the paper is to find out the best practices, implications, and limitations of AT when learning English as a foreign language within the Scopus and Web of Science (WoS) databases of open access for the last 10 years, i.e., from 2013 to 10 May 2023, to better equip teachers and involved specialists to support these learners and provide them with effective and quality education, which do not differentiate them from their sighted peers.

The research questions in the study are the following:

Q1. What are the best practices from the studies of 2013 up to 2023 in the field of AT for students with disabilities in the area of teaching English as a foreign language?

Q2. What are the pedagogical implications from the studies of 2013 up to 2023 in the field of AT for students with disabilities in the area of teaching English as a foreign language?

Q3. What are the limitations from the studies of 2013 up to 2023 in the field of AT for students with disabilities in the area of teaching English as a foreign language?

METHODOLOGY

This review study follows PRISMA methodology for systematic reviews and meta-analyses. The search was conducted between 2013 and 10 May 2023, i.e., in the last 10 years when there has been in rapid growth in emerging technologies, including AT. In addition, only experimental studies dealing exclusively with the use of AT in learning English as a second or foreign language with a special focus on their implementation in English language classrooms were included in this review. Theoretical, descriptive, observational, and non-experimental studies were excluded from the search as the main aim was to look for empirically verified findings. The search was conducted in two well-established databases, i.e. Scopus and WoS in the titles of the articles, their abstracts, and keywords as this is sufficient to generate a reliable and adequate core of articles to be further analyzed.
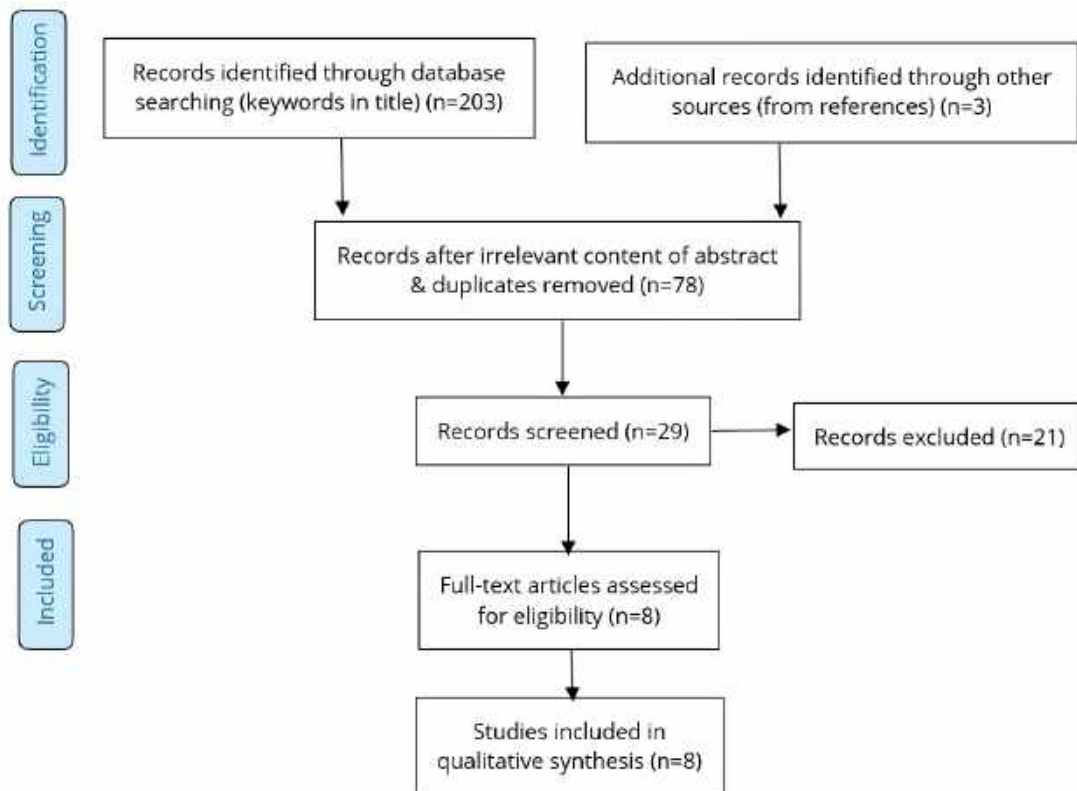
Figure 1. PRISMA flow chart: Identification of studies (Source: Authors)

Inclusion Criteria

1. Only experimental studies focusing on the research topic
2. Published from 2013 until 10 May 2023
3. Scopus and WoS databases
4. Peer-reviewed and only English-written journal articles were included
5. Search terms were applied in the title, abstract, or keywords of the articles
6. Experimental studies with specific practical outcomes for learning English as foreign language with AT
7. Open access

Exclusion Criteria

1. Descriptive and theoretical studies, conference proceedings, case studies, and observational studies
2. No open-access studies
3. Studies written in another language than English
4. Studies published before 2013

Search String

Our search string is, as follows: ("Assistive technology" AND "foreign language learning") OR ("Assistive technology" AND "English as a foreign language")

The initial search using this search string generated 112 documents from Scopus and 91 studies from WoS. After applying all inclusion and exclusion criteria and removing duplicates, five studies could be considered to be analyzed, which was a very small sample of studies. Therefore, the authors conducted a backward search, i.e., they searched the references of detected studies for relevant research studies that could be missed during their research in the databases mentioned above and definitely corresponded to the research aim and questions. This generated another three studies. Thus, altogether eight experimental studies were identified for the full-text analysis (**Figure 1**).

Data Analysis

To ensure the quality assessment of the included studies was conducted, the authors made sure that all the studies were relevant to the research questions, reliable, and methodologically sound. Moreover, the assessment of the studies was done by both authors to ensure objectivity and reliability of generated data.

RESULTS

After the search, we elicited eight articles that fit our established criteria published from the year 2013-2023. To summarize, the countries the studies come from are Turkey, Greece, Thailand, Scotland, Indonesia, Pakistan, and Oman. The research sample in the study ranged from 10 participants to 53 ranging from young learners, middle schoolers, to young adults, and university students (16-25). The most common methods used were semi-structured interviews (Arslantas et al., 2019, Khan & Mahmood, 2022, Siyabi et al., 2022), but also vocabulary and retention tests (Arslantas et al., 2019), online questionnaires (Drigas et al., 2013), and comparative data analysis (Hersh & Mouroutsou, 2015), and qualitative research in form of a case study and observations (Hamid et al., 2022).

Students in these studies appreciated their instant access to the content, individualized instructions, tracking their progress, exploiting the Internet more, using of Braille, audio storytelling, 3D objects, which all led to more autonomy, independence, and celebration of students' success. The gadgets the learners used focused mostly on the improvement of vocabulary (Arslantas et al., 2019) and reading for VI students.

The pedagogical implications are in favor of creating a program that would equal learners with their sighted peers for better education and employment (Arslantas et al., 2019, Drigas et al., 2013). It is encouraged to create a technological center, more accessible content with the provision of different accessible computing devices such as screen readers on their PCs and laptops (Hersh & Mouroutsou, 2015). On the other hand, there is a lack of teacher training for this type of students (Hersh & Mouroutsou, 2015), better development of the programs and devices of AT, as well as access to the public to support a better pedagogical inclusion of these leaners (Siyabi et al., 2022).

Table 1 provides an overview of the results from the detected studies.

Table 1. An overview of key findings from detected studies

Study & origin	Objective	Research sample & tools used	Outcome measures	Findings	Pedagogical implications
Arslantas et al. (2019) & Turkey	To design, develop, & test instructional effectiveness of a web-based English vocabulary drill program developed for VI middle school students.	15 participants (middle school students, 10 males, & five females); web-based drill program aimed at vocabulary units (friendship, tourism, chores, & science) in terms of both spelling & semantics	Semi-structured interviews, vocabulary, & retention tests	Students appreciated instantaneous access to content, individualized instruction, & tracking their own progress. Also, results revealed that students made substantial progress with vocabulary test on 80% success criterion.	To carefully design program for VI students, make content accessible, & apply relevant teaching strategies.
Drigas et al. (2013) & Greece	To explore e-learning practices & applications of people with visual & hearing disabilities; to support distance and lifelong education & training of target group, & to minimize digital divide.	E-learning application; 53 people (16-25 years old) in Greece	Online questionnaire	Deaf & hearing-impaired people use & are willing to exploit the Internet further.	E-inclusion of disabled people & their equal access to education & employment.

Table 1 (continued). An overview of key findings from detected studies

Study & origin	Objective	Research sample & tools used	Outcome measures	Findings	Pedagogical implications
Hamid et al. (2022) & Indonesia	To investigate learning English of visually impaired students through assistive technology of JAWS and MELDIC.	Qualitative research and progressive case studies– observation and interviews	JAWS and MELDIC	Students with visual impairments gained new skills & strategies in all language skills, to encourage learning English through use of JAWS & MELDICT; to become an independent student.	Practitioners should receive additional debriefing or training to strengthen their pedagogical and psychological capacities to deal with special needs students.
Hersh and Mouroutsou (2015) & Scotland	To provide data from a 15-country study about disabled people and ICT learning technologies and their access to education.	15 different countries - a part of the work of the Enable Network project.	Comparative data analysis	English-speaking countries or countries with one of the dominant languages - UK, Australia and Ireland, Germany and Italy.	To produce open versions of AT, to provide screen readers, on all their PCs, laptops, & tablets; to build an assistive/learning technology center, provide computing devices, ensure qualified technical, support personnel, & perform more research in field.
Khan and Mahmood (2022) & Pakistan	To examine the role of AT in English language learning of blind and VI students.	10 blind and VI students at the university in Pakistan	In-depth and semi-structured interviews	More success in submitting and completing tasks by using AT leading students to be more autonomous.	AT needs to be more developed.
Lo et al. (2019) & Taiwan	To examine hearing and speech-deficient people.	A hearing-impaired student in her junior year	Case study – Questionnaire, interview, design thinking, and user experience	Development of an assistive hearing device.	Promotion of system in same target groups, extended to other fields (e.g., communication in daily life), provided to other teachers in specialized schools.
Phichiensathien and Inpin (2021) & Thailand	To identify challenges & needs of young VI of English, to develop multi-sensory material of English vocabulary with touch & sound senses.	Thai young learners of English	Overview of research	using Braille, audio storytelling, and 3D objects in the Thai context are effective ways of developing the English vocabulary of VI learners.	Teachers should know VI learners, their perceptions of language and vocabulary acquisition, and material design.
Siyabi et al. (2022) & Oman	To support inclusive pedagogy in English language classrooms to make all students equal.	VI students in Oman	Semi-structured interviews	Students became more independent, empowered, & their academic success was enhanced.	To support teachers to implement the inclusion of VI students.

The greatest benefit of AT for the disabled in learning a foreign language is that they have better access to the learning materials through devices, such as a screen reader. Additionally, they work at their own pace and the program is adjusted to their individual requirements (Arslantas et al., 2019, Siyabi et al. 2022). Interestingly, if the staff is well-trained, they can help learners adjust to their speed and preferences. The

drawbacks lie in the fact that these gadgets are costly and there is a need for a larger number of such devices. Again, if the teacher or specialist is not well-trained, he/she might not help the learner profoundly, and extra training is needed (Hamid et al., 2022).

DISCUSSION

We have identified two similar systematic review studies (Fernández-Batanero et al., 2022; Jiang et al., 2022) performed on the same sample of learners that identified the best trends, practices, pedagogical implications, and limitations of AT of only VI learners. The studies confirmed that AT helped with the inclusion of disabled students, however, they also confirmed that teachers needed to be more trained and educated in the use of these devices when teaching disabled students. Furthermore, students need to be more informed about the options, however, there is still a problem with accessibility (Fernández-Batanero et al., 2022), which was also proved in our reviewed studies. The findings show that most learning technologies are available in English, followed by French, German, Italian, and Spanish. Thus, minority European or non-European languages are in general at a disadvantage (Hersh & Mouroutsou, 2015). Therefore, the European language equality network (Way & Rehm, 2022) provides five key areas to focus on when developing digital equality for all European languages within Europe by 2030, including minority languages, such as Machine Translation, for both written and spoken language or data and knowledge acquisition, curation, persistence and standardization across all languages. Additionally, the findings maintain that many ICT technologies have not been developed to be adjusted to disabled learners from the start, and additionally, modification is very costly (Brodin, 2010; Fernández-Batanero et al., 2022; Haleem et al., 2022).

Regarding our first research question on trends of AT, the study proved that most research came from recent years. Interestingly, as found out by the Fernández-Batanero et al. (2022) study, there was scarce research on AT prior to 2017 because of not profoundly accessible development of technologies for VI learners. Our study, on the other hand, provides the most relevant research in the last year–2022. The reason behind that is that there is a boom of technologies nowadays, especially artificial intelligence (AI), which might be the promise of equal learning opportunities for this type of learner. However, recent research indicates there is still small coverage for disabled people (Lillywhite & Wolbring, 2020), and the development and implementation of an AI dialogue system in learning English as a foreign language, in general, is still in its infancy stage (Zhai & Wibowo, 2023). Furthermore, the countries, where the research was performed are worldwide ranging from European countries to Indonesia and Thailand. Fernández-Batanero et al. (2022) review found on the other hand that the most involved countries were the United States followed by Brazil and Turkey. This means that the research in AT is most developed in these interested countries, and professionals really care about the betterment of this type of learner.

When it comes to the second research question on pedagogical implications, our study confirms that students using AT are becoming more independent, autonomous (Khan & Mahmood, 2022), and are better at digesting the learning material, and have better results in tests (Arslantas et al., 2019). It is the devices and proper training of specialists and educators who help them get these results, so to say, an adjusted learning plan to their needs and capacities. The positive impact of AT on learners' engagement and their academic success was confirmed in the review by Fernández-Batanero et al. (2022) as well. Also, as Jiang et al. (2022) suggest that assignments for disabled students should be tailored to their cognitive and language skills, they should build on the strengths of the students and should be in synchronicity with their individual requirements. The same is applied to the teachers who should be clear and concise in their instructions to this type of learner.

The third research question on the limitations of the research in AT field found out AT still needed to be developed and be accessible to disabled learners more, which was also emphasized by Fernández-Batanero et al. (2022). It needs to be pointed out that there should be close cooperation of all stakeholders, such as software developers, teachers and end-users, i.e., disabled learners, in order to meet the needs of this target group of learners on the one hand, and on the other hand, to secure their safety and accessibility to this technology (Klimova et al., 2023a, 2023b). Apart from that, teachers and specialists need to be provided with specialized training and have access to newly developed gadgets for disabled learners (cf. Lynch et al., 2022).

CONCLUSIONS

The paper brought a systematic review of the studies in the area of AT when learning English as a foreign language and disabled students. It explored best practices, pedagogical implications, and limitations done in the field from 2013-2023. The findings suggest that implementing AT within the inclusion of students is successful, however, there is still much room for promotion and accessibility to the learners to help them become autonomous, independent, and more confident and motivate them for better academic achievements. It should be noted that teachers and learners through AT should develop teaching and learning strategies simultaneously so that they can help better each other and make classroom time more meaningful and usable.

Future research on the topic is highly needed for better equipment for these learners with AT. The potential for further study might be in the regional mapping of learners, for example, research in Europe that might have an impact on the different territories. Obviously, as technologies in general develop, AT and research within the topic will be on the rise, therefore, a new systematic review in the next few years will be needed.

This systematic review study is limited to two most renowned databases: WoS and Scopus. Therefore, it is suggested to explore in further research other databases to explore best trends and practices that are not so known. Also, the study might be expanded in a way that the researcher will only concentrate on the specific country and make recommendations within that country to make it more individualized while taking into consideration all factors that a country entails, number and age of disabled students who need AT, then accessibility of devices to this group of learners, and ideally, the potential of making technological centers.

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