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REVIEW ARTICLE

Research on Computer-Assisted Interpreter Training: A Review of Studies from 2013 to 2023

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Abstract
Thanks to the rapid development of technology, there has been an increasing number of studies integrating technologies into language teaching and learning over the past few decades. Under the auspices of technology, interpreting education has also experienced a transformation from traditional teacher-led classrooms into learner-centered and interactive paradigms. While the use of technology has been extensively investigated and reviewed in English language teaching contexts, especially English as a second/foreign language, computer-assisted interpreter training (CAIT) has been under-researched and reviewed. This paper aims to provide a bird's-eye view of ways in which interpreting learning has been reconciled with different types of technological tools. This paper systematically reviews 36 articles on CAIT from 2013 to 2023 and surveys the major patterns and development trends. It traces how technology over time has been incorporated into interpreter training and summarizes the state-of-the-art application of technology in CAIT. The findings suggest that there has been a steady increase in pedagogical research on CAIT, in particular empirical studies on learning outcomes and students' perceptions of higher education in European countries. Various technological tools have been examined, and the results generally indicate that the benefits outweigh the drawbacks. The paper concludes with some insights into future studies. Based on theoretical frameworks, more experiential research is needed to examine the effects of multiple emerging technologies in various language contexts. More studies are needed to explore the contextual, individual, and influencing factors from both teacher and student perspectives.

Keywords Computer-assisted interpreter training · Development trends · Interpreting teaching and learning · Review · Technology-assisted language learning

Introduction

In line with the expansion of the language services market and the huge demand for translation and interpreting services, there is an increasing amount of relevant training. In response to the boost in the development of training programs, there has been a steady growth in the literature on interpreter education (e.g., [3, 44]. Despite this growth, research on interpreter training is lacking and is largely outnumbered by studies on translator training [34]. Numerous researchers (e.g., [10, 49] have emphasized that more studies are needed in the future to help interpreters and trainers tackle the problems they encounter and advance the teaching and learning effectiveness of interpreter education.

In terms of course content, formal interpreter training generally includes a wide range of subject areas such as language consolidation, subject-specific knowledge, cultural knowledge, interpreting theories, interpreting techniques and skills, professional and ethical knowledge, and interpreting practice [19, 30, 50]. Ko's [21] survey of 17 interpreter trainers in three interpreting programs in Australia demonstrated that teaching interpreting requires a high level of verbal and visual interaction. It is believed that interpreter training requires an advanced level of live, direct, and dynamic verbal and visual interaction [22], Riccardi 2002). Thus, its effectiveness may largely depend on the feasibility of teaching these skills by adapting appropriate pedagogies and technologies. Over the last

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few decades, studies have provided strong evidence that the appropriate use of technology can effectively enhance teaching and learning (e.g., [23, 32, 45]. Similarly, more and more researchers [9, 25, 29] have stressed the importance of incorporating technology into interpreter training.

In recent decades, there have been an increasing number of attempts to integrate technologies into interpreting practices and education, and thus computer-assisted interpreter training (CAIT) has been gaining more attention. Sandrelli and Jerez [40] stated that "CAIT is a relatively new field of Interpreting Studies, which began to develop in the mid-1990s. The impetus behind CAIT is an attempt to exploit the multimedia capabilities of Information and Communication Technology (ICT) to enhance the teaching and learning of interpreting in various ways" (p. 269). In fact, the development of ICT has had a significant influence on interpreter training. The importance of integrated ICT in interpreting teaching has been widely acknowledged in the literature (e.g., [2, 6, 33, 39]. Pöchhacker [37] stated that, "research on interpreting research was in part driven by technological innovation" (p. 73) and "the ongoing trend toward the technologisation of interpreting is likely to continue" (p. 74). Yan et al. [48] findings also revealed the importance of technology in interpreter training. Echoing Pöchhacker, the findings of Yan et al. [49] study also pointed out that "technologies should see a wider application in interpreting training in the future" (p. 70). The importance and popularity of CAIT have been accelerated by the COVID-19 pandemic. To address the strong need for online learning, various tools, such as videoconferencing applications and communication platforms (e.g., Zoom and Microsoft Teams), have been used to ensure student engagement. It is generally suggested that the use of technology enhances remote learning and blended learning as well as facilitates teacher-student interaction [36]. Nonetheless, technology cannot totally replace the essential role of human interpreter trainers and real-life authentic interpreting practice [10].

CAIT has contributed to the development of interpreting pedagogy by innovating teaching strategies, providing access to learning materials, and spurring the development of solutions to teaching and learning constraints [16]. Thus, CAIT has become a more important area for teaching methods and studies that could extend current research on students' satisfaction with technological tools and move towards a systematic theoretical and methodological framework for learning and teaching practice.

While fast-changing technology has played an increasingly significant role in interpreter education, there is a lack of comprehensive review focusing on the technologies used in CAIT, in particular, the different types of technological tools and their effects on teaching and learning. Moreover, in spite of the growth of studies examining the impact of CAIT, systematic reviews of prior literature are scant, especially in the last decade.

In order to explore how technologies influence interpreting teaching and learning from a research perspective in accordance with technological trends and development, this paper aims to review the studies on CAIT from 2013 to 2023, to highlight the main features and trends of CAIT in the last decade, and to suggest a valuable direction for future research. The synthesized and collected analysis will summarize the findings of relevant literature, identify the major research issues, and provide insight into further studies.

This paper specially addresses the following research questions:

- What are the overall trends in the use of technology in interpreter training?
- What are the research participants in the relevant studies?
- What are the areas/issues of CAIT examined?
- What are the technologies and tools adopted in CAIT?
- What are areas of learning investigated in terms of modes of interpreting and languages?

Related Literature Reviews

Translator and interpreter (T&I) training has developed rapidly since the last century. The number of translation and interpreting university-level training programs worldwide has significantly increased in response to the increasing demand for language services [11]. The expansion and institutionalization of the field of T&I training contribute to the burgeoning development of research on T&I education. However, research on interpreter training is relatively limited compared to a large number of translation and interpreting studies [34]. In particular, there is a lack of review studies that have proven useful for practitioners, teachers, and researchers to gain an overall understanding of a certain field, identify paradigm shifts and development, and reflect on its progress to guide future work [17, 18], Yan et al. 2013).

Among the limited reviews on T&I training research, Yan et al. [48] conducted a summative analysis of ten translation and interpreting journals based on their database of articles from 2000 to 2012. The analysis of the database was conducted using a combination of top-down and bottom-up thematic analysis and corpus analysis tool. The results revealed that research on T&I training has been increasing since the millennium, and the majority of papers contributed to translation training instead of interpretation training. In terms of the sub-category of "technology and training," they suggested that e-learning and the use of online resources and computer-aided tools have been receiving more attention. The authors highlighted that "due to the growing application

of technology to T&I training, it is envisaged that publications in this subcategory will increase over the coming years and that more theoretical approaches to the application of technology in T&I training or the construction of training modules on T&I technologies will appear in the field" (p. 279). While this review does not solely focus on interpreter training, it indicated that the concepts related to T&I training in this fast-changing digital era may need a redefinition.

With a specific focus on interpreter training, Yan et al. [49] expanded the database to include journal articles from 2000 to 2014 and unveiled the trend of interpreter training after the new millennium. The findings indicated that the number of articles on interpreter training steadily grew, and the most active areas/countries were the greater China area (26 entries) and Spain (23 entries). The majority of studies covered three major themes—teaching, learning, and assessment. The title analysis revealed that simultaneous interpreting received more attention than consecutive interpreting. In terms of disciplinary typology, there was an increasing number of studies on public service/community interpreting, including healthcare interpreting, legal interpreting, and sign language interpreting. While the teacher-dominance feature was found, technology played a more important role in interpreter training, which echoed the findings of Yan et al. [48]. About 10% of the reviewed studies were related to "technology and training." The common topics included virtual learning, distance learning, and CAIT.

Focusing on comparing journal articles on translator training and interpreter training during the period from 2000 to 2013, Pan et al. [34] found that articles on translator training outnumbered those on interpreter training. They suggested that studies on translator training and interpreter training share a thematic and methodological framework but have different research foci and methods. For instance, while translator training appeared to concentrate comparatively more on teaching, interpreter training, although also teaching-oriented, covered more from the learning perspective.

It appears that there is only one review focusing on CAIT. Xu and Deng [46] reviewed major research on integrating ICT into interpreter training in China during the past decade. The findings showed that technological innovations contributed to the dramatic changes in interpreter training in China. A wide range of pedagogical factors (e.g., teaching models, principles, materials, strategies, assessment, and trainer/trainee roles) have been explored. The review pointed out that the prominent criticism lies in the overemphasis on the macro-perspective, i.e., the general discussion on the possible impacts and teaching principles without an in-depth evaluation of the actual effectiveness of the application of ICT tools in interpreter training. They concluded that more efforts should be made in the development of professional technical tools, and more empirical research on their effectiveness is needed.

Despite the increasing significance of the role of technologies in interpreter education and practice, the prior literature on CAIT has yet to be systematically and comprehensively reviewed. Previous reviews have only covered research on interpreter training in general, without a specific focus on the use of technologies in interpreting teaching and learning. In addition, the studies covered in these reviews were mainly published more than a decade ago, and the types of technical tools have rarely been analyzed. Although Xu and Deng [46] reviewed some major studies in this field, they solely focused on a single technology (ICT) and one country (China). The limitations of previous literature reviews reveal the need for a more detailed analysis of prior research on CAIT. This paper thus aims to provide a comprehensive review of the development trends of CAIT worldwide over the past decade, including the overall trend, research participants and issues, and technological tools as well as learning areas. It not only gives an overview of the current status of CAIT but also offers insights into research needs for future work.

Research Methods

This study aimed to map studies on CAIT and identify the trends and patterns of technology in interpreter training. Unlike other disciplines, there is a lack of a unified citation index in translation and interpreting studies [20]. Thus, the articles were not selected based on a single citation index. With reference to the methods used in the review studies (e.g., [26, 48] and PRISMA checklist [38], relevant studies published during the period of 2013–May 2023 were collected from publication databases, including Web-of-Science. The keyword expressions used in the data retrieval included "computer-assisted," "technology," "interpreting," and "interpreter training," etc. These papers were further selected based on the following criteria: (1) the paper was written in English (given the use of English as an academic lingua franca, (2) the full paper was accessible; and (3) the paper was related to CAIT. A total of 36 studies were selected for review and analysis.

The features of the selected articles were coded, analyzed, and categorized based on the dimension adapted from relevant review studies on technology-supporting language learning (e.g., [27]. This included authors, years, categories of publication, tools/technologies, learning areas, interpreting modes, language pairs, participants, methodology, and research issues. The categories were further divided into sub-categories. For example, the participants were analyzed by their background (e.g., students, teachers, and in-service interpreting practitioners) and levels of education (e.g., certificate, undergraduate, postgraduate, occupational training). In addition, areas of learning were classified by modes

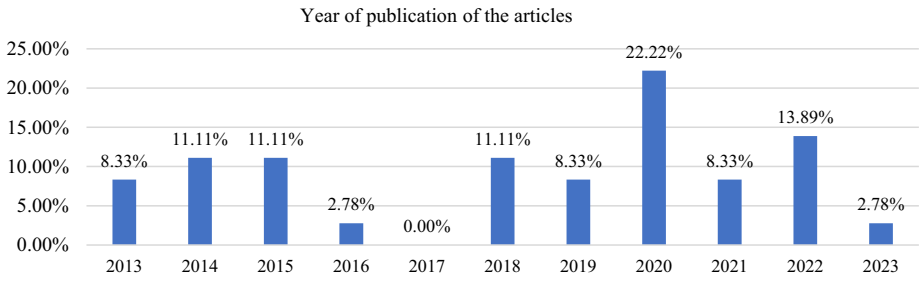


Fig. 1 Year of publication of the articles

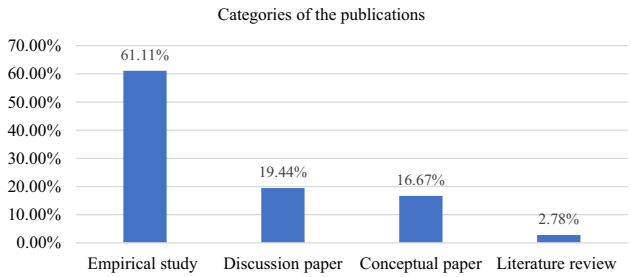


Fig. 2 Categories of the publications

of interpreting [based on the working modes of interpreting–simultaneous, consecutive, and sight interpreting [13]] and languages. In terms of the themes of research issues addressed in previous studies, a bottom-up procedure was adopted, as described in Yan et al. [49]. Each data entry was independently read, and a code that could best describe the features was assigned.

Results

Overall Trend Over the Past Decade

Figure 1 demonstrates the year of publication for each paper on CAIT from 2013 to May 2023. In general, the number of studies in this field kept increasing with small ups and downs. Among the 36 articles reviewed, about one-third of them were published in the period between 2013 and 2017. The upward trend of growth was more obvious in recent years, which indicated that CAIT has received increasing attention, especially during and after the COVID-19 pandemic.

In terms of the categories of the papers, Fig. 2 presents the distribution of categories of the publications. About 61.11% of the publications were empirical studies, followed by discussion papers (19.44%) and conceptual papers (16.67%), which proposed a technological tool or computer-assisted interpreting course. There was only one literature review which focused on the use of ICT in CAIT in China.

Research Participants

In general, a large proportion of CAIT studies focused on student learning in higher education.

Types of Participants

Figure 3 illustrates that the majority (72.73%) of participants are students or interpreting trainers. There were a few studies (13.64%) that examined both perspectives of the teachers/trainers and students/trainers. While most research focused on the university setting, less than 10% of them explored the

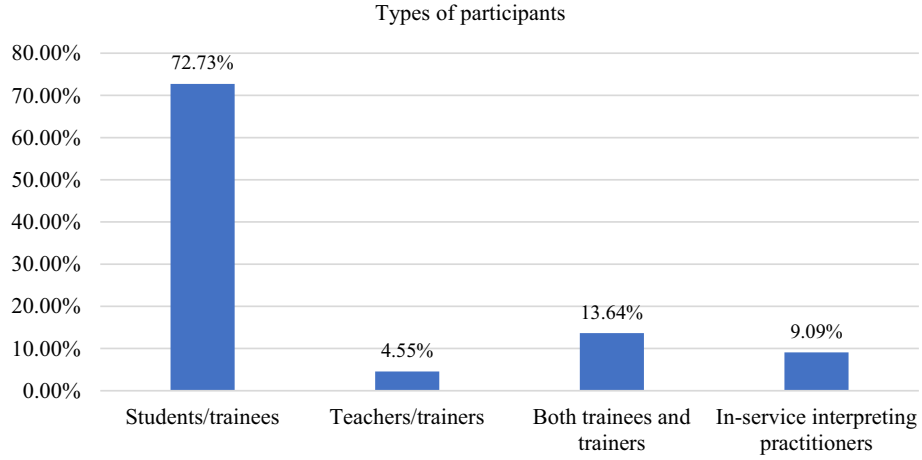


Fig. 3 Types of participants

perceptions of in-service interpreting practitioners in real-life interpreting practice.

Levels of Education

As far as students were concerned, most studies were conducted in higher education settings. As shown in Fig. 4, half of the research participants in the reviewed studies were undergraduate students, and about a third were postgraduates. There were only two studies focused on occupational training. This pattern is mainly attributable to the fact that many interpreting courses are generally offered at the university level.

Research Issues

Research Themes

Figure 5 shows the distribution of the research issues covered in the reviewed research. Several main themes were identified, including learning outcomes (24.49%), engagement (22.45%), and perception (16.33%). The common research issues of learning outcomes consisted of proficiency level and interpreting performance (e.g., [9, 10]. In terms of engagement, various aspects were covered, such as interaction (e.g., [14] and motivation (e.g., [15]. In addition to empirical studies investigating the effectiveness of CAIT, some publications generally discussed the role of technology (14.29%) and outlined the idea of adopting a new technological tool (8.16%). It was observed that there was a lack of studies focusing on theoretical frameworks, and there were scant publications that especially proposed a competence framework (e.g., [43] and adopted theoretical models.

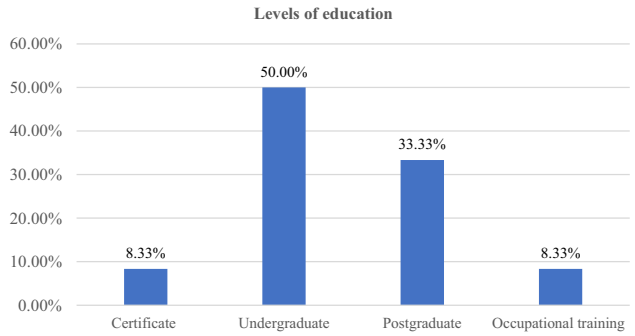


Fig. 4 Levels of education

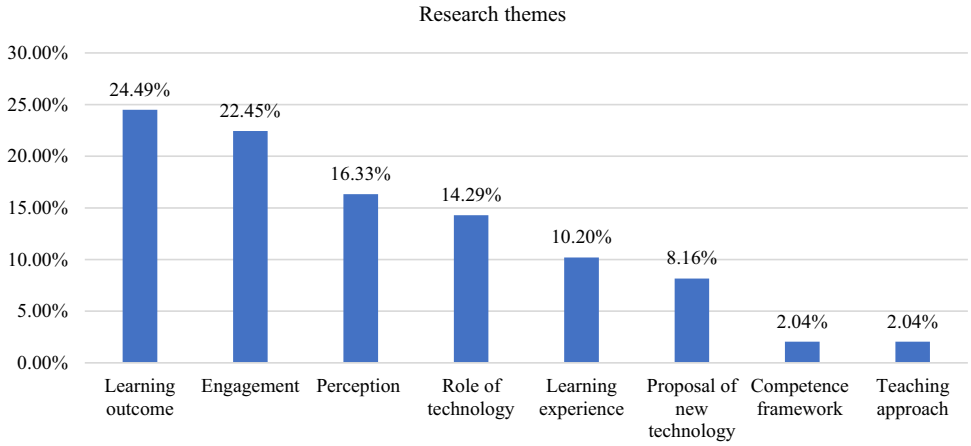
Research Methods and Instruments

Among the empirical studies, 11 studies adopted surveys and five studies used the mixed method. It was observed that a large number of studies evaluated the effectiveness of CAIT by students' perceptions (e.g., satisfaction in Lee and Hun [24]) and self-rated proficiency levels. Only some of them (e.g., [10] compared and measured both students' actual performance and their perceptions and self-reported levels of proficiency. In terms of the length of the study period, many of them evaluated the effects over a semester, whereas there was only one longitudinal study (i.e., [1]. Furthermore, while there were five experimental studies, the majority of the research was exploratory and expository. In addition, the sample size of the studies was generally small, except for some survey-based studies (e.g., [31], which involved over 100 participants.

Results of CAIT

As far as the impact of CAIT was concerned, the results of the majority (90.91%) of research indicated that the incorporation of technologies into interpreter education contributed to numerous affordances. Common benefits identified included enhancement of interpreting competence (e.g., [7], learning motivation and experience (e.g., [9], and learning effectiveness (e.g., [41]. Although some limitations were reported, the advantages generally outweighed their

Fig. 5 Research themes



drawbacks and challenges. A few of the publications demonstrated mixed views of CAIT. For instance, Lee and Huh [24] found that trainees had positive attitudes, whereas the trainers had mixed opinions on CAIT. As mentioned in some discussion papers, technology changes not only the interpreting practice, but also the roles of professional interpreters, interpreter teachers, and students. Thus, it appears that trainers must acquire not only state-of-the-art interpreting technology, but also teaching and learning technology for pedagogical purposes.

Tools and Technologies

Figure 6 illustrates the types of tools and technologies adopted in the reviews studied in the last decade. The commonly used technologies and applications included course management systems/online teaching platforms (19.44%), virtual reality (VR) (22.22%, including both desktop-based and mobile-based), ICT (11.11%), and computer-assisted interpreting (CAI) tools (11.11%). In general, the results of the reviewed studies demonstrated that the benefits of CAIT outweighed the shortcomings regardless of the types of technological tools employed.

Traditionally, interpreting instruction takes place in language labs where teachers prepare pre-recorded speeches for in-class practice and play the audio/video files. This training method has been criticized for its lack of authenticity. Over the past decade, there has been a way of increasingly integrating technologies into interpreting practice and education, such as three-dimensional (3D) virtual learning environments and VR. In terms of VR, the early studies mainly focused on desktop-based VR, while more research has been adopting mobile-based, fully immersive VR in recent years. Three publications on the use of desktop VR were based on the same European research project, "Interpreting in Virtual Reality [IVY]," which is an influential VR research project for interpreter training funded by the European Commission and divided into various stages (e.g., Braun and Slater [4, 42. For example, with the use of *Second Life*, Braun and Slater [5] provided an outline of the development of the first immersive (avatar-based) 3D virtual environment dedicated to interpreter-mediated communication to simulate interpreting practice. Instead of depending on a single technology, recently, some studies (e.g., [9, 10] combined various types of technology (e.g., mobile and fully immersive VR technologies) in CAIT. In addition, due to the COVID-19 pandemic, more studies focused on the evaluation of technology-enhanced online learning. For instance, Perez and Hodakova [36] investigated the influencing factors in remote training during the pandemic, and Yan and Fan [47] examined the online informal learning community for interpreter training amid COVID-19. It appears that the pandemic has accelerated the development of CAIT, and more innovative technological tools and new pedagogies have become more prevalent.

Areas of Learning

The reviewed studies covered various modes and contexts of interpreting as well as language pairs and directions.

Modes of Interpreting

Interpreting is mainly classified into types and subtypes based on the working mode [13]. When categorizing according to mode, there are three major types of interpreting: simultaneous, consecutive, and sight interpreting. In consecutive interpreting, the interpreter consecutively starts rendering the target language version after the speaker has stopped speaking, whereas simultaneous interpreting requires an interpreter to reformulate the speech into a target language at the same time the speaker talks. The findings revealed that consecutive interpreting was commonly performed in contexts of conferences and community settings, which involved dialogue interpreting.

Figure 7 illustrates the percentages of types of interpreting examined in the studies in the review period. In terms of types of interpreting, larger numbers of studies focused on

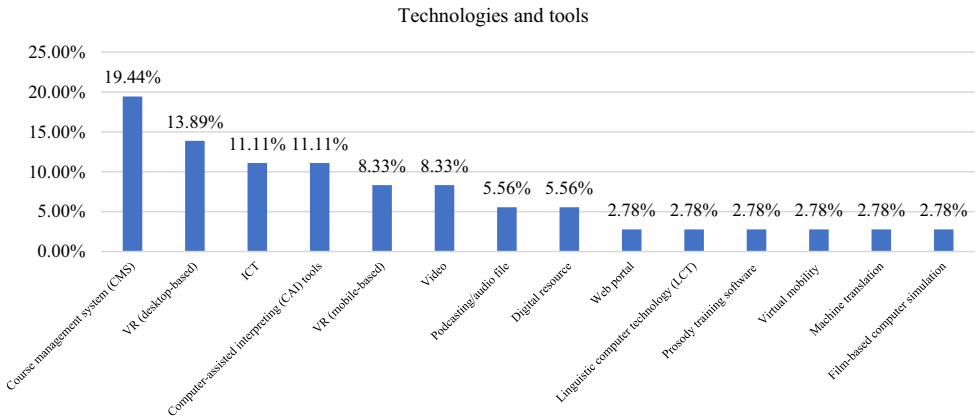


Fig. 6 Technologies and tools

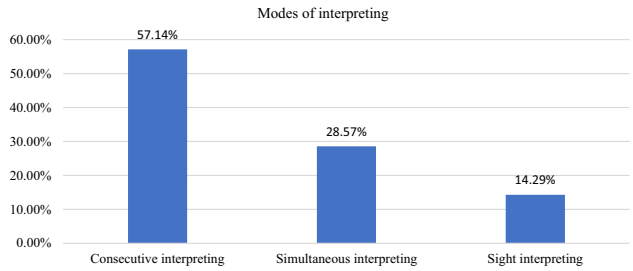


Fig. 7 Modes of interpreting

consecutive interpreting (52.14%), followed by simultaneous interpreting (28.57%), and sight interpreting (14.29%). While about 60% of CAIT studies did not focus on interpreter training in a specific context, community (e.g., public and medical services) and business settings accounted for 28% and 12%, respectively. These patterns are consistent with the need for interpreting services and curriculum features of interpreting courses. In general, sight translation is regarded as the basis of consecutive interpreting and simultaneous interpreting.

Languages

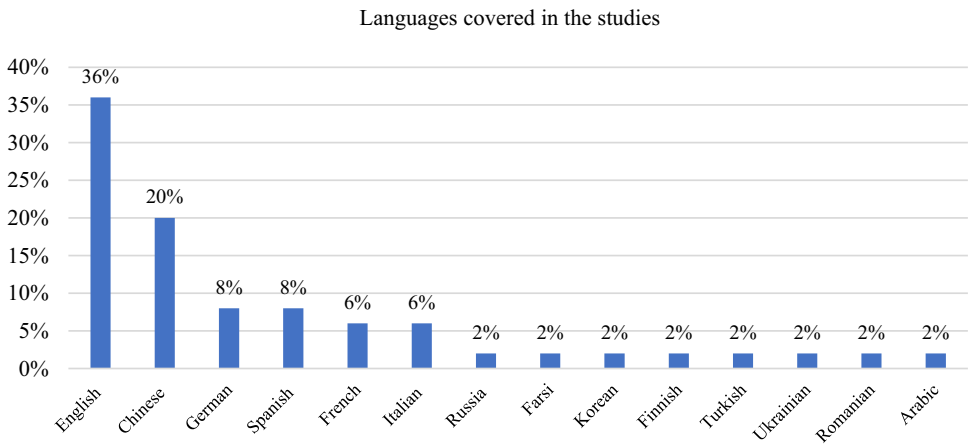
Figure 8 presents the proportion of languages covered in the reviewed research. English (36%) was studied most, followed by Chinese (20%), Spanish (8%), and German (8%). The findings suggested that the majority of studies focused on European languages, especially English, which has the largest number of speakers, as a lingua franca. It may also be due to the selection criteria of this review, i.e., only publications in English. Moreover, it is worth noticing that while the language pairs and directions are important in interpreting, some articles did not specify this information clearly. In terms of language directions, only about a third of the studies covered bi-directional CAIT, and the others focused on mono-directional interpreting learning.

Discussion and Conclusions

The findings of this study reveal the trends and patterns in the use of technologies for interpreting teaching and learning. This paper supplements the findings of related reviews (e.g., Pan et al., 2015; [49] with a specific focus on CAIT and covers the latest publications globally. In line with the related reviews, CAIT has drawn increasing attention and has become more widely implemented in interpreting courses. Echoing Xu and Deng [46], a larger number of studies have explored a wide range of pedagogical factors, including teaching principles, training materials and strategies, online learning, the efficacy of CAIT, and teacher/student roles. Owning to the technological advancement, there is a growing number of emerging technologies. Following this trend, research on CAIT has also shifted its focus from conventional tools to innovative technology. For example, VR learning environments have become more prevalent, and some recent studies have started integrating different types of technologies and investigating the combined effects of multiple technologies. Moreover, it is observed that there was a sharp increase in publications in 2020, possibly due to the abrupt shift to online teaching and remote learning during the COVID-19 pandemic. Some studies (e.g., [1, 47] especially evaluated the remote online teaching and online learning community during the pandemic.

In terms of categorizing the papers—unlike Yan et al.'s [49] and Xu and Deng's [46] reviews, which found that there was a lack of empirical research—the findings of this study showed that over 60% of publications were empirical studies. This suggests that there has been a growth in empirical research in recent years. Another difference is that while the theoretical concern/framework was identified as one of the major research themes in some prior reviews (e.g., Pan et al., 2015; [49], which covered studies on general translator and interpreter training, the

Fig. 8 Languages covered in the studies



theoretical framework is rarely addressed in the reviewed studies of this paper, which focuses on CAIT. It seems that research in the area of educational technology has often been criticized for its lack of solid theoretical grounding, which can guide effective instructional design and evaluate the quality of teaching and learning [35]. Among the limited CAIT research that is based on theoretical frameworks, constructivism (e.g., [9] and the interpreter competence model (e.g., [10] were most commonly deployed. Wang and Li [43] proposed a three-dimensional competence framework for interpreting technologies, which consists of the composition of awareness of interpreting technology, learning of interpreting technology, as well as skills and knowledge of interpreting technology. Future research on CAIT may develop interpreting learning tools and evaluate the effectiveness of technology in interpreter training based on these theoretical frameworks.

With regards to the type of participants, the highest proportion of studies focused on students in the higher education context. This could have been caused by the levels of interpreting programs available in the market. Interpreting is rarely found in the secondary school context, and the majority of programs are at undergraduate and postgraduate levels. While most research focuses on pre-service interpreter training, studies related to in-service interpreting practitioners were scant. Moreover, previous studies mainly examine students' perceptions from the learning perspective, whereas the teaching perspective has been under-researched. Numerous researchers (e.g., [12] have stated that teachers' perceptions of learning technologies play a significant role in the success of integrating learning technology into classrooms. In particular, the learner-centered CAIT may have a potential conflict with the conventional teacher-centered approach. Thus, future studies may have to examine perceptions from both teacher and student perspectives in order to provide more comprehensive analyses of the changing roles of teachers, students, and technologies in CAIT. For instance, future research may explore the teachers' technological competence levels and Technological Pedagogical Content Knowledge (TPACK) needed as a professional interpreter trainer in this fast-changing digital world.

In line with previous reviews of technology-enhanced language learning (e.g., [26], learning outcomes, engagement, and perceptions are the common types of research issues. Surveys are the most frequently used research instrument to evaluate the effectiveness of CAIT. To avoid the limitations of self-rated changes in competence and performance, some studies employed pre- and post-tests (e.g., [28] and adopted the mixed method (e.g., [10]. The findings also revealed that most empirical studies are based on an exploratory approach, whereas there is little research that contains experiential groups to compare the effects of CAIT and conventional teaching. Similar findings were reported by Pan et al.'s (2015) review, which showed that observational studies were the majority compared to experimental studies. One of the possible reasons for this may be the difficulty of data collection caused by the small class size and single group nature of interpreting courses. It is not rare that only one class of a particular interpreting course is offered in a semester. Thus, it is more challenging to have two separate groups of students from the same course for comparison. The small sample size of studies might be due to the small class size of interpreting courses, generally less than 20 students per class.

Regarding the effects of CAIT, positive attitudes and numerous benefits are generally found in terms of the participants' perceived satisfaction, the usefulness of the tools, and their learning experience and outcomes. In particular, VR technology can provide interpreting students with immersive and situated learning, which enhances learning effectiveness, motivation, engagement, and interpreting competence, while the use of mobile applications facilitates learning autonomy and flexibility and reduces time and location constraints. Despite the positive impacts commonly reported in the studies, some publications also state the possible drawbacks of CAIT. For instance, findings of Lee and Huh's [24] research on blended mode business interpreting indicated that some trainers pointed out that online written feedback, without gestures, intonation, and facial expressions, was less engaging, and most of the trainees received the trainer feedback passively. On account of the evolution of technology, a number of video conference tools (e.g., Zoom and Microsoft Teams) can reduce these limitations of written communication and allow online video meetings and instant textual and verbal communication. In fact, the success of CAIT may depend on various individual and contextual factors, such as students' motivation and proficiency levels, availability of resources (e.g., technological tools and finical budget), and teachers' technological acceptance levels. Hence, more studies are needed to investigate the influencing factors of CAIT and to explore how these factors affect the success of CAIT.

Concerning the technologies and tools used in the studies, the major devices have generally changed from traditional video and audio podcasting to VR learning environments. In addition to the technological tools adopted in language labs, there has been an increasing number of online platforms (e.g., computer-assisted platform in Lim's [2013] study) and mobile applications (e.g., mobile-based VR interpreting practice application in Chan's [2022, 2023, [8]] research). It is observed that research on CAIT not only covers the enhancement of face-to-face interpreting teaching but also blended learning, remote learning, and autonomous self-study. Further studies may explore and compare the effects of technology tools in various contexts, such as face-to-face teaching, blended learning, and online distance learning.

In terms of modes of interpreting, the findings reveal there has been a change in researchers' attention over time. The present review reveals that more than half of the review studies (2013–2023) focus on consecutive interpreting. This finding is inconsistent with the result of Yan et al.'s [49] review, which found that researchers put more attention on simultaneous interpreting than on consecutive interpreting during 2000–2013. CAIT is more commonly adopted in consecutive interpreting (e.g., community and dialogue interpreting), which could be caused by the different numbers of consecutive and simultaneous interpreting courses. Consecutive interpreting is generally regarded as a compulsory element of the curriculum of interpreting programs, whereas simultaneous interpreting is commonly offered as an elective for advanced learners. Thus, the number of consecutive interpreting-related courses is generally larger, and so there could be a stronger pedagogical need for the incorporation of technology in interpreter training. With respect to language directions and pairs, some articles did not clearly specify the source and target languages or the directions. Future studies may examine and compare the impact of CAIT in different language contexts.

In conclusion, the findings suggest that there has been a steady increase in research on CAIT over the past decade, in particular empirical studies on learning outcomes and students' perceptions of higher education in European countries. Various technological tools (e.g., CMS, VR, and ICT) have been used for consecutive and simultaneous interpreting learning contexts, and the results generally suggest that the affordances outweigh the drawbacks. The findings of this paper contribute to how technology assists interpreter training worldwide, and the patterns and trends in research and development on CAIT in the past decade. Overall, there is a growth of pedagogical research on CAIT, especially empirical studies on learning outcomes and students' perceptions of higher education in European countries. Various technological tools have been investigated, and the results generally suggest that the benefits outweigh the drawbacks. Based on theoretical grounding, future research may explore the development of emerging technology for interpreter education and the effects of combining technologies in various language contexts with an experimental group using a mixed method as well as a larger sample size. The use of technology alone is not sufficient to maximize the effectiveness of teaching and learning; more studies are needed to explore the contextual, individual, and influencing factors (e.g., curriculum design, availability of resources, and users' technological skill) from both teacher and student perspectives.

In spite of its implications, this study has limitations. For instance, publications in languages other than English and ones not listed in the publication databases were not included. Nevertheless, this study provides a glimpse of the global picture of research on CAIT, which constitutes a worthwhile first step in reviewing the prior literature, reflecting on the development of CAIT and the role of technology in interpreter education, and providing insights for the direction of future research.

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