A bibliometric analysis of the trends, topics, and findings of research publications on asynchronous and synchronous online language learning over three decades

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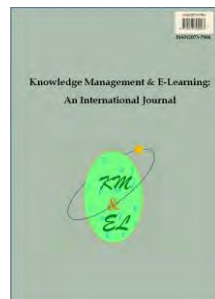
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Abstract: Since the first study on computer-mediated communication tools in support of language learning was published in 1992, asynchronous and synchronous tools have been widely adopted; however, few reviews have been conducted to explore the research status in this field. As COVID-19 has increased the use of online tools in education, the need to understand how asynchronous and synchronous tools are being used in language education has grown. In this bibliometric analysis, we reviewed asynchronous and synchronous online language learning (ASOLL) by analyzing the trends, topics, and findings of 319 articles on ASOLL. The results indicate that interest in ASOLL has increased over the past three decades with ASOLL for oral proficiency development and collaborative ASOLL being the two main research issues. Interest in three topics

– collaborative ASOLL, emotions, and corrective feedback – was especially apparent. The review contributes to the understanding of ASOLL while providing practical implications for using information communication technologies to enhance language learning.

Keywords: Synchronous learning; Online learning; Language learning; Bibliometric analysis

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1. Introduction

Online learning, which can be in synchronous, asynchronous, or hybrid modes, has gained an increasingly important role in education, especially during the Covid-19 pandemic (Perveen, 2016). Synchronous online learning refers to real-time communication as students and teachers meet on a digital platform, allowing students to ask questions and receive a real-time response; asynchronous learning refers to communication not coordinated in time, which allows students to complete online activities at their own pace (Basaran & Yalman, 2020; Serdyukov, 2020). Hybrid learning combines synchronous and asynchronous learning and provides both simultaneous learning sessions and non-simultaneous learning activities (Perveen, 2016). Synchronous learning emphasizes participation, where students interact with their classmates in real-time (Serdyukov, 2020) with more engagement in active learning and a greater feeling of social presence (Bower et al., 2015). Asynchronous learning, which is more flexible (Serdyukov, 2020), allows students to learn at their own pace with less peer pressure (Basri et al., 2021). In language education, asynchronous learning provides more opportunities to use the target language, while synchronous learning allows face-to-face interaction (Perveen, 2016).

The spread of Covid-19 has further triggered the transition from traditional face-to-face learning to virtual learning. The temporary closure of institutions moved teaching and learning online to enable continued education (Weldon et al., 2021). Because tools permitting asynchronous computer-mediated communication (ACMC) and synchronous computer-mediated communication (SCMC) have also been widely used in language education, existing reviews have mainly considered the effectiveness of these two learning modes (e.g., Lin et al., 2013; Martin et al., 2021). However, few studies (e.g., Parmaxi & Zaphiris, 2016) have reviewed research on synchronous and asynchronous online language learning (ASOLL). Further, most reviews have focused on synchronous and asynchronous learning in general education rather than language education. For example, Martin et al. (2021) reviewed the cognitive and affective educational outcomes of synchronous learning, and Watts (2016) reviewed students' interactions in the asynchronous and synchronous learning environments. Therefore, in this review, we examine the research trends and foci of ASOLL research in papers published from 1992 to 2021 using a bibliometric analysis to reveal gaps in the literature and identify potential research topics. The following research questions guided our review:

(1) What trends have appeared in ASOLL research?
(2) What were the main research topics in the field of ASOLL?
(3) What were the main findings of the representative articles in ASOLL?

2. Literature review

This section summarizes the main findings of representative reviews on asynchronous and synchronous learning and notes their limitations.

2.1. Asynchronous learning

Thomas (2013) reviewed 14 studies published between 2006 and 2012 using the narrative synthesis approach. He explored the factors that affected the use of Asynchronous Online Discussion (AOD) in health care education and found that most studies adopted qualitative, quasi-experimental, and mixed-method approaches. The mode of an e-moderator (AOD facilitator), the provision of clinical settings, and the amount of time spent reading were the key factors that influenced AOD effectiveness. Thomas recommended educators use specific frameworks for discussion, offer settings for critical thinking, and increase the reading time to enhance the effectiveness of AOD.

Young and West (2018) explored how Asynchronous Multimedia-based Oral Communication (AMOC) tools improved speaking skills by systematically reviewing 22 articles published before 2016. They found that AMOC tools developed students' speech accuracy, fluency, and pronunciation and concluded that AMOC should be integrated into preparatory activities, project-based learning, self-evaluation, and revision to enhance students' oral skills. The authors also summarized the challenges when using AMOC, including poor internet connections, hardware deficiencies and malfunctions, and insufficient experience in using hardware and software.

2.2. Synchronous learning

Lin et al. (2013) focused on text-based SCMC in second language learning in a meta-analysis of 10 studies between 1990 and 2012. They reported that oral performance was frequently examined in the studies, followed by lexical and grammatical aspects. Text-based SCMC had a small but positive effect on learners' acquisition. The researchers also found that language proficiency, target language, learning conditions, treatment duration, and grouping dynamics affected language learning. Based on the results, they suggested that SCMC should be conducted in mid- or mixed-level settings, last for mid- and long-term periods, be used for foreign language learning, and be integrated into group activities.

Martin et al. (2021) conducted a meta-analysis of 19 articles published from 2000 to 2019 to investigate the effects of synchronous learning on cognitive and affective educational aspects. They found synchronous online learning had a more significant impact on cognitive outcomes than asynchronous learning. Course duration, instructional methods, student equivalence, learner level, and discipline all had moderating effects. They concluded that future synchronous online courses should be shorter than one semester, include non-random assignments targeted at graduate or professional students, and be taught interactively to promote cognitive outcomes.

2.3. Synchronous and asynchronous learning

In a systematic review of 24 articles investigating online learning environments published between 2006 and 2014, Watts (2016) focused on the role of asynchronous and synchronous interactions, covering three aspects: transactional distance, course outcomes, and motivation. Watts found that both types of interaction helped engage students in learning, thereby enhancing their motivation and achieving course outcomes. The author recommended that educators consider time constraints, technological ability, and motivation before implementing online learning.

Parmaxi and Zaphiris (2016), who conducted a systematic review of ACMC and SCMC tools on computer-assisted language learning (CALL) in studies from 2009 to 2010 identified core concepts that emerged from this field. Five SCMC themes were identified, including: learners' cognitive and affective development, differing SCMC modes, tasks and design in SCMC, problem-solving strategies adopted in SCMC, and comparative studies. For ACMC, they found that the affordances of ACMC modes and learners' strategies were mainly discussed. In sum, the review revealed the great potential of ACMC and SCMC tools for language learning.

All of these reviews, however, have been limited in several ways. Most of them have adopted a systematic approach or meta-analysis focusing on demonstrating the effectiveness of asynchronous and synchronous learning (Table 1). They evaluated a limited number of studies but failed to provide a quantitative assessment of the research field to reveal potential topics for future research. Given that asynchronous and synchronous learning became a normal practice during the Covid-19 period, it appears necessary to provide an overall picture of the research status of ACMC/SCMC-supported learning. One way to do this is through a bibliometric analysis, which is effective for reliably assessing a particular research area (Chen et al., 2020b). Further, previous studies have reviewed articles that focused only on synchronous or asynchronous learning (e.g., Martin et al., 2021; Thomas, 2013) without investigating a specific educational field (e.g., Martin et al., 2021; Watts, 2016). Previous studies demonstrated that both asynchronous

and synchronous tools facilitated students' language acquisition (e.g., Perveen, 2016), asynchronous and synchronous learning should be widely used to facilitate language learning. Therefore, this review focuses on the status of ASOLL research, aiming to identify the research trends and latent topics of ASOLL research using a bibliometric analysis to fill these gaps.

Table 1
Summary of reviews on asynchronous/synchronous learning

Study	Type of review	Number of papers reviewed	Focus of review	Major findings
Reviews on asynchronous learning				
Thomas (2013)	A systematic review	14	Asynchronous online discussion in healthcare education	Providing asynchronous online discussion in clinical settings helped learners reflect, analyze, and resolve clinical issues.
Young and West (2018)	A systematic review	22	Asynchronous multimedia-based oral communication in speaking skills	Asynchronous multimedia-based oral communication was used to promote learners' speaking fluency, accuracy, and pronunciation
Reviews on synchronous learning				
Lin et al. (2013)	A meta-analysis	10	Synchronous computer-mediated communication in second language learning	Text-based CMC had a small but positive effect on second language learning; intermediate learners may benefit more from a SCMC task when they were in group learning.
Martin et al. (2021)	A Meta-analysis	19	Synchronous learning on cognitive and affective educational outcomes	There was a statistically significant effect in synchronous versus asynchronous online learning for cognitive outcomes.
Reviews on asynchronous and synchronous learning				
Watts (2016)	A systematic review	24	Asynchronous and synchronous communication in distance learning	Time constraints, technological ability, and motivation are the key factors that affect students' interactions in online settings.
Parmaxi and Zaphiris (2016)	A systematic review	33	Asynchronous and synchronous computer-mediated communication tools in computer-assisted language learning	Eleven themes of CMC tools on CALL were identified: Learners' cognitive and affective development in SCMC, Exploration of different SCMC modes, Task and system design in SCMC, Problem-solving and strategies employed within SCMC, Comparative studies, Affordances of various ACMC modes, Learners' strategies in different ACMC modes, Comparative studies

3.   Materials and methods

Bibliometric analyses can provide an up-to-date overview to examine the evolution of topics in educational technology (e.g., Chang et al., 2022; Chen et al., 2020b) and language learning (e.g., Chen et al., 2021; Zou et al., 2022). More importantly, they can identify patterns in a wide range of publications based on the characteristics of studies (Zou et al., 2022). Thus, this method was adopted for the current review to provide insights into the field of ASOLL.

3.1. Data selection

Web of Science (WoS), one of the major online data resources for bibliometric analyses (Luo & Zou, 2022), was chosen as our dataset. It has frequently been used for bibliometric analyses in the education technology field (e.g., Chang et al., 2022; Chen et al., 2020a; Chen et al., 2020b; Chen et al., 2021; Zou et al., 2022) housing one of the most widely used collections of reputable journal articles (Chen et al., 2020a; Zou et al., 2022). We typed (Synchronous OR asynchronous) AND (online OR computer OR mobile OR technology OR web) AND (learn* OR teach* OR communicat*) as the search terms for generating articles' abstracts and used (Synchronous OR asynchronous) AND (online OR computer OR mobile OR technology OR web) AND (learn* OR teach* OR communicat*) for generating paper titles. The source type was limited to peer-reviewed scholarly journals. In June 2021, 3,954 articles were generated. After duplication (N = 216), we excluded 7 articles without abstracts, leaving 3731 articles for further screening (Fig. 1). Two domain experts screened the articles based on the following criteria: (1) the learning approach used in the study had to be F; (2) the research had to be related to learning; (3) the learning subject had to be related to language; and (4) the article had to be original research. Through this process, 3,340 articles were screened out, leaving 391 articles.

3.2. Representative article search

A further screening of the most representative articles followed a few steps. First, we ranked the 391 articles based on citation counts according to Google Scholar. Although Google Scholar tends to include lower quality articles along with high quality ones, it is still a promising tool for assessing the impact of journal articles (van Aalst, 2010). Second, we extracted the articles published in Quartile 1 language and linguistics journals based on the 2020 SCImago Journal Rank (SJR). SJR is a metric that ranks scholarly journals based on citation weighting schemes and eigenvector centrality (González-Pereira et al., 2010) and is a reliable indicator of journal quality frequently used in language reviews (e.g., Al-Hoorie & Vitta, 2019; Zhang & Zou, 2020). Finally, we selected the 10 most-cited articles published in influential journals for analysis. In March 2022, all these articles had more than 400 citations.

3.3. Structural topic modeling

We adopted structural topic modeling (STM) proposed by Roberts et al. (2019) to incorporate arbitrary metadata into the topic model. First, we extracted terms from the titles and abstracts of the selected papers using natural language processing techniques. The term frequency-inverse document frequency (TF-IDF) was employed in the next step to evaluate the importance of the terms. We included terms with at least 0.04 TF-IDF in this review.

As Chen et al. (2020b) suggested, we ran a set of models with topic numbers from 5 to 20. Two domain experts compared the models with different topics and selected the 12-topic model since all the terms in the model could form a meaningful topic, and the terms were highly related. All important topics of ASOLL were included, and there was no overlap of the topics in this model. Following Chen et al. (2020b), we labeled the topics using the following steps: (1) generating statistical results based on the topic importance related to the ASOLL; (2) obtaining the most discriminating terms according to the distribution matrix of topics and terms; and (3) labeling the topics. In the third step, two domain experts independently labeled the topics by interpreting the semantic meanings of each key term and analyzing each topic's representative articles. Finally, the experts compared the labeling results and discussed the results until there was no disagreement to ensure consistency.
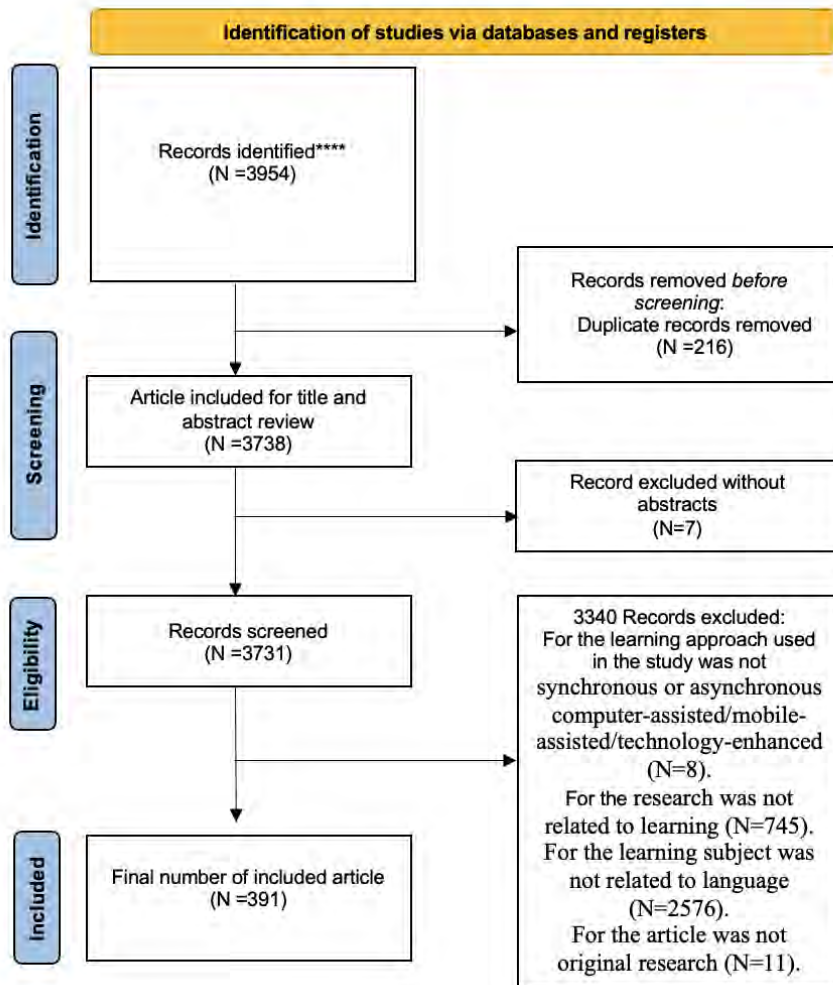

Fig. 1. Data selection

4. Results

This section presents our findings regarding the publication trends, main research issues, and representative research findings.

4.1. Research publication trends

To answer research question 1, trends in ASOLL research over the past three decades (1992-2021) are presented in Fig. 2. As shown, research interest in the field of ASOLL increased over the period. The number of studies increased steadily from 1992 to 2005, and then there was a sharp increase in 2009. Since then, the number of publications has fluctuated. Another large increase was observed in 2017, with the highest number of publications (41 articles). However, it dropped again near the end of the period of coverage.
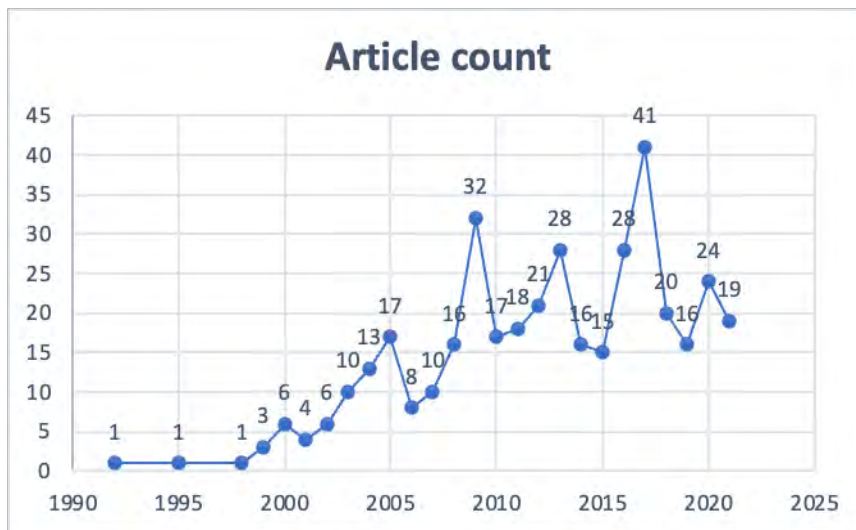

Fig. 2. Analysis of the number of publications of ASOLL studies

4.2. Topic proportions and developmental trends

The STM technique was used to identify the 12 most frequently discussed topics in ASOLL research to answer research question 2. As shown in Fig. 3, ASOLL for speaking proficiency and collaborative ASOLL were the two most popular topics, accounting for 11.24% and 11.22% of the publications, respectively. ASOLL research focusing on language teachers' professional development, i.e., teacher training (10.76%) and pre-service teacher training (9.49%) were the third and fourth most investigated topics. The fifth most popular topic was identity in ASOLL (8.87%). Two topics, assessment and effectiveness of ASOLL, held the sixth and seventh position at 8.17% and 7.68%, respectively. Four topics shared similar frequencies: multimodal of ASOLL (6.93%), emotions (6.74%), corrective feedback (6.73%), and motivation and attitude (6.4%). Among the 12 most frequently investigated ASOLL issues, game-based ASOLL was the least investigated topic, accounting for only 5.77% of the reviewed articles.

As for developmental trends, Fig. 3 (indicated by the arrows) also shows that 11 topics experienced increasing research interest, with the effectiveness of ASOLL being the

only topic having decreasing interest. Specifically, interest in three topics – collaborative ASOLL, emotions, and corrective feedback – significantly increased at the $p < 0.001$ level. Three more topics – assessment, multimodality of ASOLL, and motivation and attitude – experienced significantly increasing interest at the $p < 0.05$ level. Four topics: ASOLL for speaking proficiency development, teacher training, pre-service teachers in teaching, and identity in ASOLL experienced significantly increasing interest at the $p < 0.01$ level. Studies on game-based ASOLL increased over the period, but not to the point of statistical significance. Studies investigating the effectiveness of ASOLL declined, but the decrease was not statistically significant.
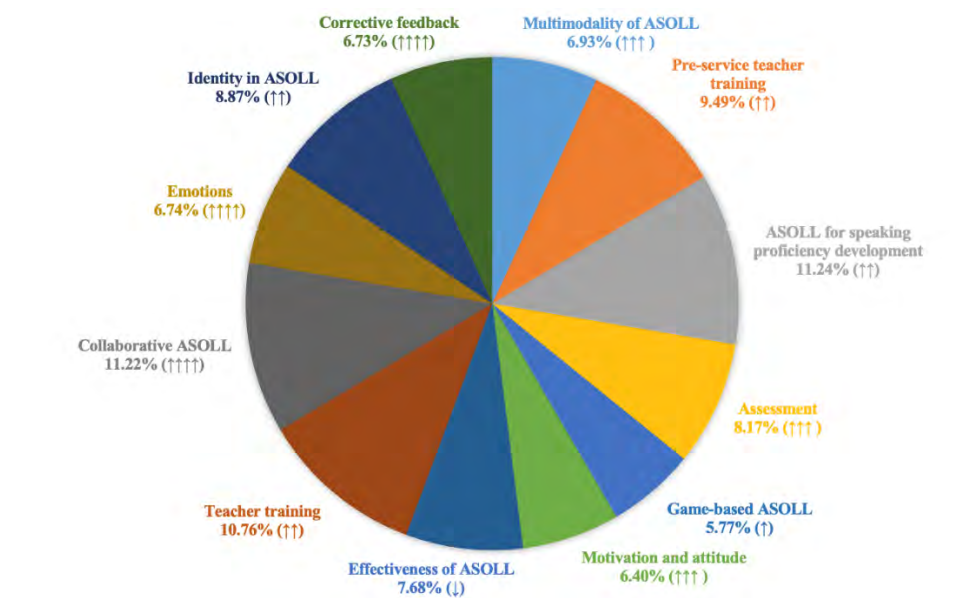

Fig. 3. Analysis of topic frequencies and developmental trends

Note. ↑ (↓): Increasing/decreasing trends but not significant ($p > 0.05$); ↑↑/↓↓, ↑↑↑/↓↓↓, and ↑↑↑↑/↓↓↓↓:
Significantly increasing/decreasing trends ($p < 0.05$, 0.01, and 0.001)

Fig. 4 illustrates the trend lines of the proportional topic distribution of the 12 topics from 1992 to 2021. As shown in the figure, the multimodality of ASOLL shows a generally steady trend spiking only in 1998. Pre-service teacher training drew little attention in the first period (1992-1998), after which it fluctuated with the number of articles reaching peaks in 2006 and 2018. Interest in ASOLL for speaking proficiency development increased from 1992 to 2003, then a decreasing trend was observed; however, it increased again starting from 2006 reaching the highest number of publications in 2010. The topic of assessment grew from 1992 and reached its peak in 2001. Afterwards, the number of articles on this topic declined. Regarding game-based ASOLL, the article frequency reached its highest in 1999 and showed a decreasing trend thereafter. Over the years, the frequency of articles on motivation and attitude fluctuated, with the highest numbers in 1999 and 2006. The effectiveness of ASOLL attracted researchers' attention at the first stage (1992-1995), while not much attention was drawn in the following years. The frequency of articles on teacher training kept rising from 1992 and reached the highest level in 2000, after which it declined; however, it regained researchers' interest in the latest seven years. Articles on collaborative ASOLL witnessed an increasing trend until 2009, although

it decreased in the following few years before increasing again in 2018. For the first 10 years, emotion was not a focus of research after which article frequency fluctuated reaching a peak in 2021. Articles on identity in ASOLL were few until 1999 but have been frequent over the latter part of the period fluctuating considerably. Research attention on corrective feedback kept increasing and achieved the highest frequency in 2006 and continued to be investigated afterwards.
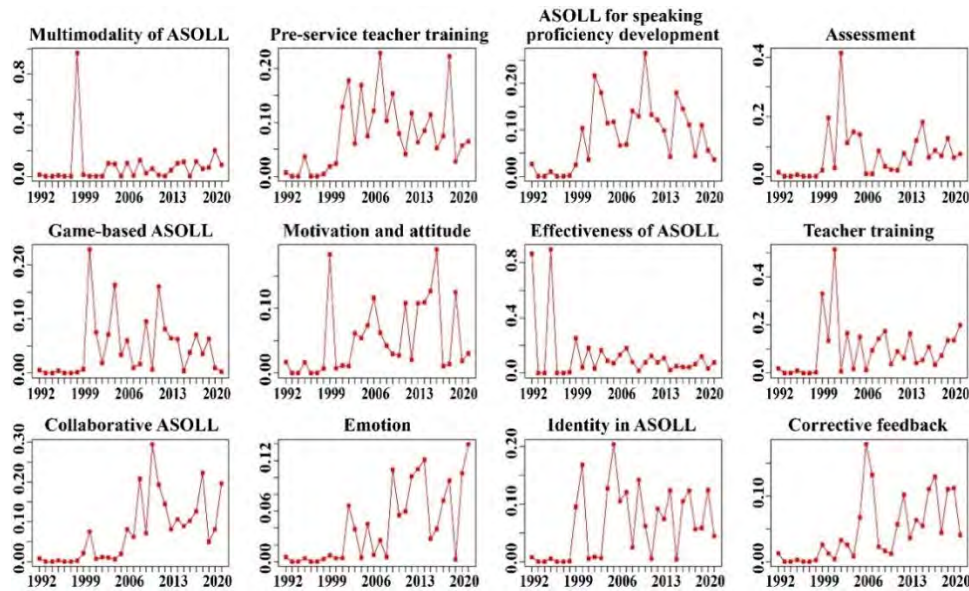

Fig. 4. Analysis of proportional topic distribution

In the earlier stage of ASOLL development (1992-1998), the effectiveness of ASOLL was the main concern. During that period, asynchronous and synchronous learning was a new way to support language learning, and its effectiveness was frequently explored. From 1999 to 2005, researchers shifted their attention to several topics: pre-service teacher training, ASOLL for speaking proficiency development, assessment, teacher training, and identity in ASOLL. This suggests that applications of ASOLL became diversified and were not limited to enhancing students' learning. ASOLL was also used for teacher development as well as student evaluation. Research interest in collaborative ASOLL grew from 2006 to 2012. Pre-service teacher training, ASOLL for speaking proficiency development, game-based ASOLL, teacher training, and identity in ASOLL were frequently investigated. From 2013 to 2019, pre-service training, teacher training, and collaborative ASOLL remained the main focus. Notably, research interest in emotion significantly increased during this period.

4.3. Major research findings of representative articles

In this section, we report the main findings of 10 representative empirical studies on ASOLL in response to research question 3. We divided these studies into three categories and summarize their primary information in Table 2.

Table 2
Summary of representative articles

Authors	Titles	Journals	Citation counts (by 22 Mar 2022)
Kern (1995)	Restructuring classroom interaction with networked computers: effects on quantity and characteristics of language production	*The Modern Language Journal*	1733
Blake (2000)	Computer mediated communication: A window on L2 Spanish interlanguage	*Language Learning & Technology*	1129
Sotillo (2000)	Discourse functions and syntactic complexity in synchronous and asynchronous communication	*Language Learning & Technology*	917
Payne & Whitney (2002)	Developing L2 oral proficiency through synchronous CMC: Output, working memory, and interlanguage development	*CALICO Journal*	681
Abrams (2003)	The effect of synchronous and asynchronous CMC on oral performance in German	*The Modern Language Journal*	662
Elola & Oskoz (2010)	Collaborative writing: Fostering foreign language and writing conventions development	*Language Learning & Technology*	543
Ware & Kramsch (2005)	Toward an intercultural stance: Teaching German and English through telecollaboration	*The Modern Language Journal*	486
Arnold & Ducate (2006)	Future foreign language teachers' social and cognitive collaboration in an online environment	*Language Learning & Technology*	439
Smith (2004)	Computer-mediated negotiated interaction and lexical acquisition	*Studies in Second Language Acquisition*	419
Hampel (2006)	Rethinking task design for the digital age: A framework for language teaching and learning in a synchronous online environment	*ReCALL*	409

4.3.1. The effectiveness of ACMC/SCMC for language learning

Kern (1995) investigated students' language production quantity and characteristics when using InterChange, a kind of digital chatbox, and during oral discussion sessions. Students' comments on InterChange would pop up on the screens of all group members, all of whom were free to respond. It was found that students produced two to four times more sentences during InterChange sessions than in oral discussion sessions. Students also tended to use a greater variety of discourse functions (e.g., greetings, assertions, and questions) during the InterChange sessions. The written nature of InterChange allowed students to have more time to think and compose their messages, thereby enhancing their language production. InterChange also enabled all students to participate in the discussion and provided more opportunities for expression, resulting in greater production.

Payne and Whitney (2002) investigated the effectiveness of SCMC on oral proficiency development. Participants in an experimental group received face-to-face instruction and online classes in a researcher-designed chatroom. A control group held the same activities in a face-to-face classroom. Results indicated that learners in the SCMC group scored significantly higher in oral proficiency development than the control group. The chatroom environment reduced students' burden by allowing them to read previous comments, slowing down the pace of discussion. Students were also active learners in the online environment, contributing to the discussion and monitoring their language use by themselves, demonstrating the benefits of synchronous learning.

Sotillo (2000) investigated the discourse functions and syntactic complexity in two different CMC modes (i.e., synchronous and asynchronous). Students participated in synchronous discussions using a real-time chatware, Internet Relay Chat. Another asynchronous threaded discussion was assigned to one group of students. Based on the discussion data, students tended to post short messages in synchronous discussions as they needed to spend time reading their classmates' postings and giving responses immediately. In the asynchronous discussions, discourse functions were limited to questions and responses similar to traditional classrooms. There were significant differences in error-free clauses between the two learning modes which implied that students have more time to plan and pay more attention to grammar in asynchronous discussions.

Abrams (2003) compared the effects of ACMC and SCMC on students' oral performances. Students participated in real-time discussions through a WebCT chat tool or delayed-time interaction via a WebCT bulletin board. Students' oral output was recorded by audiotape and analyzed in terms of communication units (c-units), lexical richness, lexical density, and syntactic complexity. Results indicated that students in two CMC groups produced more language during discussion than those in a face-to-face communication group. However, there was no significant difference between the ACMC and the control group possibly because students in the ACMC group had lower motivation as they needed to wait for their peers' comments, leading to reduced performances.

The effectiveness of ASOLL was one of the major research concerns of the ASOLL community. The representative studies suggested that ACMC/SCMC tools effectively enhanced students' oral proficiency (Abrams, 2003; Payne & Whitney, 2002) and discourse function (Kern, 1995; Sotillo, 2000). These studies explained why and how CMC tools support language learning. For example, students showed more types of discourse functions in synchronous discussions than in asynchronous ones (Sotillo, 2000). Students in synchronous discussion sessions were required to give quick responses, which led to more discourse types (e.g., explanation clarification, information requests, and off-topic comments). These findings provided implications for encouraging more types of discourse functions in online discussions. These representative articles were frequently cited in subsequent articles showing the significance and value of using ACMC/SCMC tools for developing language proficiency (e.g., Arnold & Ducate, 2006; Bower et al., 2015).

4.3.2. *The application of ACMC/SCMC for language learning*

Blake (2000) analyzed how language learners negotiate meaning (i.e., resolving miscommunication) using Remote Technical Assistance, a chat program that enabled students to share text synchronously. Students communicated with their partners to solve the following tasks: one-way/two-way exchanges of information in tasks (only one or both members could access all the information to find a solution); jigsaw tasks (participants

receive different information to find a solution; and decision-making tasks (both members have equal access to the information but they are not forced to find a common solution). According to the transcripts of the written interactions, jigsaw tasks stimulated the most negotiations possibly because such tasks required each partner to request and contribute to the solutions when pooling resources.

Elola and Oskoz (2010) compared individual and collaborative writing when students used different technologies. Students wrote on PBwiki and communicated with peers using voice chat in the university's system. After discussion, they completed a writing task individually or collaboratively; however, findings revealed there were no significant differences between individual and collaborative writing. Students mainly used chats for topic development, discussing structure, and information gathering since they were allowed to address specific concerns in real time. For wikis, thematic sentence construction and internal coherence were the main focuses as learners were allowed to focus on grammatical detail and editing matters. In sum, the results showed that different social tools allowed learners to concentrate on writing components in a complementary manner.

Smith (2004) analyzed which type of interactionally modified input (negotiated interaction vs. preemptive input) facilitated students' ability to recognize and produce lexical items. Preemptive input occurs when learners describe an unknown object without explicit indication, whereas negotiated interaction signals incomplete understanding. ChatNet was used to support real-time communication. Participants were paired up and then chatted with others to complete jigsaw and decision-making tasks. According to Smith, the unknown lexical items that were negotiated were retained better than those that were in preemptive input showing that negotiated interaction facilitated language acquisition in computer-mediated environments.

The studies covered above demonstrated how ACMC/SCMC tools could be used for language learning while providing guidelines on how to design learning tasks and choose appropriate asynchronous and synchronous tools for instruction. Blake (2000) suggested that jigsaw tasks produce the most negotiations as students need to gain information from their partners which implies that teachers could choose jigsaw tasks to increase their students' language production. The chatroom was shown to be useful as a discussion tool before writing collaboratively because they helped students brainstorm, clarify uncertainties, and develop potential topics (Elola & Oskoz, 2010). Wikis were more suitable for collaborative writing as students could view their peers' work and make immediate adjustments (Elola & Oskoz, 2010). These representative studies acted as guidelines for directing educators in lesson planning resulting in high citation counts.

4.3.3. Implications of ASOLL

Ware and Kramsch's (2005) study, which concerned the challenges of conducting an asynchronous telecollaborative project, had two groups of students (i.e., learners of German in the United States and learners of English in German) wrote in the two languages using an asynchronous discussion tool (Blackboard). They reported that the telecollaborative project allowed students to learn more about historical facts, linguistic features of speech, and discourse pragmatics. They recommended teachers to construct assignments and provide clear directions. Because their students were from different cultural backgrounds and had different ideas about national history and political ideologies,

the teachers had to help them develop perspectives from both sides and negotiate meanings considering cultural values.

Arnold and Ducate (2006) investigated social and cognitive presence in asynchronous online discussion boards. Social presence included emotional expressions (e.g., sharing feelings), open communication (e.g., referring to others' comments), and group cohesion (e.g., greetings). Cognitive presence was analyzed based on triggering (e.g., recognizing a problem), exploration (e.g., making suggestions), integration (e.g., creating solutions), and resolution (applying ideas and solutions). Upon collecting the discussion transcripts, it was found that social activity outweighed cognitive events. Regarding social presence, group cohesion occurred most frequently. As for cognitive presence, exploration and integration were the most common phenomena. Students brainstormed in the exploration stage and gathered information to develop ideas during the integration stage reflecting the nature of collaborative learning.

Hampel (2006) developed a framework for an online synchronous language learning environment. Lyceum, an internet-based application, which was adopted to enable learners to use a wide range of modes to interact synchronously. Hampel claimed that task development should focus on three levels: approach, design, and procedure. Approaches denote the theories related to language learning; the design refers to the method of analysis and the procedure refers to the actual practice. Based on this framework, pedagogical principles were integrated into language theories providing scaffolding for students to master their language skills. The designed task facilitated interaction between teachers and students and thus promoted language acquisition revealing that learning tasks should be designed differently for online multimodal environments.

The studies mentioned above provided practical suggestions for language teachers. For example, Ware and Kramsch (2005) suggested that teachers need to learn historical facts, linguistic features of speech, discourse pragmatics, and constraints of the medium, which can facilitate students' communication as teachers understand students from their perspectives. It also helped teachers enhance their teaching in the subject areas of language awareness, discourse analysis, and applied linguistics. Arnold and Ducate (2006) observed that teacher involvement and prompting were necessary for online collaborative learning. Teachers needed to provide feedback to help students confirm or reject their solutions. The framework developed by Hampel (2006) suggested that online tasks should be designed based on language theories, affordances of the medium, and learning objectives. Thus, these studies provided practical implications for educators.

5.   Discussion

Our review identified publication trends in ASOLL research while revealing that the number of studies continued to grow over the past 30 years. Since 2000, researchers have paid increasing interest to ASOLL, which is in line with Güzer and Caner (2014), who found that blended learning started to appear in 2000. We also noticed that the number of publications increased rapidly from 2007 to 2009, which was a period when blended learning became popular (Güzer & Caner, 2014). We observed another sharp increase from 2015 to 2017, which was also noted by Chen et al. (2021).

We also identified the most discussed topics over the three decades. ASOLL for oral proficiency and collaborative ASOLL were the main research foci. Consistent with previous research, ACMC and SCMC were used to develop students' speaking skills (Lin

et al., 2013; Young & West, 2018). SCMC encouraged the negotiation of meaning during interactions, improving learners' oral performance (Lin et al., 2013). As for ACMC, it allowed learners to listen to their own performance and revise accordingly, helping learners improve oral learning outcomes. With these affordances, ACMC and SCMC tools became important elements in language research. Collaborative ASOLL was the most popular topic, with research interest increasing over the years. CMC tools were used for collaborative language learning as noted by Chen et al. (2021). CMC tools allow language learners to exchange ideas, clarify uncertainties, and develop potential arguments (Blake, 2000). Newly developed technologies such as virtual reality further enhanced collaborative learning by encouraging students to work together in a simulated environment. Chen et al. (2021) also revealed the potential of using CMC tools for intercultural awareness development. However, our review did not identify this trend as we focused only on ASOLL, while Chen et al. (2021) focused on CALL and covered a wider range of technologies in their review.

The topics, emotions and corrective feedback, increased significantly in number although they were not among the top five topics over the years. Due to the pandemic, ACMC/SCMC tools were used not only for instruction but also for psychological reasons. Teachers were required to consider students' emotional status when using ACMC/SCMC tools. The topic of emotions and corrective feedback may become major issues in future research. Martin et al. (2021) also showed that researchers were focused on the effects of ACMC/SCMC tools on students' cognitive and affective aspects; however, our review focused on the research trends and topics of ASOLL research, which differed from Martin et al. The following section analyzes the research foci of different phases.

5.1. Research foci of different phases

5.1.1. Alternative ways for language learning (1992-1996)

Only two ASOLL studies were published between 1992 and 1996, both of which employed InterChange, a local computer network application that allowed participants to communicate synchronously. Beauvois (1992), who was the first to employ InterChange in a foreign language context, used InterChange to ask students questions about a reading. Similarly, students in Kern (1995) used InterChange to answer questions and discuss their ideas. These two studies showed that students had more language production in synchronous learning than in traditional classroom learning possibly because they considered the InterChange environment as a more informal atmosphere. Less attention was paid to grammatical accuracy and coherence, and increased time was spent on the discussion, resulting in the development of language learning.

5.1.2. Multimodal ACMC/SCMC in language learning (1997-2001)

Studies during this period focused on using different ACMC/SCMC tools such as computer conferencing (Skinner & Austin, 1999), email, word processors (Biesenbach-Lucas et al., 2000), and chat programs (Blake, 2000). Biesenbach-Lucas et al. (2000) found that students used more demonstrative noun phrases in word-processed texts as they perceived word processing as a formal medium. More sentence connectors were used in email texts due to their interactive nature. Blake (2000) focused on task types in developing students' communication skills and found that jigsaw tasks helped promote negotiations. This task

type required students to discuss and work collaboratively via the chat program since they had different pieces of the puzzle resulting in the development of negotiating skills. These studies provided implications for choosing different ACMC/SCMC tools and task types for language learning.

5.1.3. SCMC/ACMC tools for oral proficiency development (2002-2006)

Researchers used SCMC/ACMC tools to develop students' oral abilities during these years. Mclntosh et al. (2003) incorporated an ACMC tool called Wimba to develop speaking skills. Students who were asked to record their voices when responding during certain activities, i.e., self-introduction, small group debates, responses to questions, and note-taking assignments, contributed more posts on debating tasks which developed their oral proficiency. Abrams (2003) demonstrated that students increased the quantity of language production with SCMC tools compared to ACMC tools. Students first read a passage and discussed it. Then, they used WebCT to have a real-time electronic chat about the topic and post their comments on the WebCT bulletin discussion board. Studies in this period contributed to designing learning tasks and selecting tools for developing oral skills.

5.1.4. ACMC/SCMC tools for collaborative language learning (2007-2011)

Newly developed technologies, such as virtual reality, were used to enhance collaborative learning from 2007 to 2011. For example, Shih and Yang (2008) built a collaborative 3D virtual classroom (VEC3D) for English learning, which provided students with realistic contexts and authentic communication via a real-time voice function, promoting interactive language learning. Peterson (2010) used Second Life, which let students share their opinions in a simulated lecture theater, while their peers presented in a theater with an avatar audience. This study innovatively helped learners respond to questions by moving their avatars. The percentage of each correct answer would show on the screen automatically. These emerging tools and platforms enabled a high level of interaction and supported collaborative learning.

5.1.5. Perceptions of ACMC/SCMC tools (2012-2016)

From 2012 to 2016, researchers investigated how learners perceived ACMC/SCMC tools. For example, Elola and Oskoz (2010) found that students thought wikis helped improve their grammar, content, and structure of their writing, while voice chat benefited content and structure development. Students could exchange ideas with voice chat and correct their peers' grammatical mistakes when using wikis. Zhang et al. (2016) discussed how teachers perceived using ACMC and SCMC for role-play activities. After selecting a topic, teachers were assigned either a pro or con role to conduct a debate. Participants who shared the same position collaborated with others to formulate arguments. Although participants preferred asynchronous online role-play because it allowed them more time to think, they reported that both synchronous and asynchronous online role-play contributed to developing ideas and collaborative arguments.

5.1.6. Feedback in ASOLL (2017-2021)

With the widespread use of ACMC/SCMC tools, feedback in language studies shifted from the classroom to an online context from 2017 to 2021. It allowed the instructors to provide

effective and immediate feedback with SCMC tools and cause less confusion with ACMC tools (Ahmed et al., 2021). For instance, Shang (2017) required students to complete writing tasks and receive asynchronous peer feedback (APF) on Moodle, while gaining synchronous corrective feedback (SCF) with Cool Sentence Corrective Network. This network automatically identifies students' mistakes in writing. Based on the analysis, APF encouraged students to write more sentences, and SCF provided immediate feedback to correct errors. Similarly, Henderson (2021), who taught vocabulary via the text-chat feature of Skype, provided immediate corrective feedback (CF) to two groups, while one other group did not receive any CF during the task. Results revealed that both treatment groups significantly outperformed the control group, implying that the instructors should use both types of feedback in vocabulary learning.

5.2. Practical implications

Online learning has become a more common educational mode since the pandemic. Thus, educators need to carefully understand ACMC/SCMC tools' features before implementing them (Hampel, 2006). The synchronous learning environment provides real-time interaction, and the asynchronous learning environment allows students to learn at their own pace (Perveen, 2016). Newly developed technologies (e.g., virtual reality) stimulated real-life scenarios that enabled students to practice their language (Chiang et al., 2014). Considering these affordances, synchronous communication tools might be used to assist speaking skills as they provide more opportunities to practice the target language and reduce student anxiety in speaking (Beauvois, 1992). Therefore, researchers should consider using these tools for oral proficiency development.

Asynchronous learning can be used for collaborative writing as it helps students brainstorm ideas and provide corrective feedback (Arnold & Ducate, 2006). Our review also demonstrated the value of collaborative ASOLL. Learning was slower in online asynchronous environments as students were not required to respond immediately (Payne & Whitney, 2002). Asynchronous learning also reduced the pressure on students with lower learning abilities. Additionally, students planned their essays carefully and paid more attention to the grammar in an asynchronous learning environment (Sotillo, 2000), showing the effectiveness of ACMC tools during the pandemic when students had fewer opportunities to interact with their peers. Students' preferences for APF (Shang, 2017) and teachers' difficulties in marking many online assignments revealed the potential of peer evaluation using ACMC tools. However, teachers need to consider students' proficiency levels and give proper guidance before students evaluate their peers.

We found that collaborative learning, emotions, and teacher training have become major concerns in the past few years. Using ACMC/SCMC tools, online learning communities can be created, providing students with a supportive learning environment (Arnold & Ducate, 2006; Fageeh & Mekheimer, 2013). Accordingly, researchers should consider conducting collaborative tasks with different technologies to investigate what the affordances of CMC tools are and how they could be applied in different learning activities. Because students spent more time learning online due to Covid-19, researchers need to consider the affective aspects of students (e.g., cognitive load, emotional status, learning anxiety). As online learning is an inevitable trend, instructors need to have proper training on using ACMC/SCMC tools for language teaching. How to conduct teacher training programs online and which technologies are suitable for language learning are potential topics for future research.

6.   Conclusion

In this review, we investigated the trends and foci of ASOLL research over three decades using a bibliometric analysis. We found that studies on ASOLL increased, demonstrating the effectiveness of ACMC/SCMC tools for language learning. We also identified the main research foci over the years, providing an overview of the field while suggesting future directions. Practical suggestions for educators regarding how to use ACMC/SCMC tools in language learning were provided for language education during and after the pandemic.

However, our review focused only on the trends and research-related issues of ASOLL. Detailed information on the publications (e.g., influential journals, author affiliations, institutions) was not covered. Future research should consider including the above information for analysis to establish collaborative networks. In addition, the current review only used one dataset (i.e., WoS) to collect raw bibliographic data. Studies that also have great influence but were not included in WoS were not included in our review. Accordingly, researchers could consider using more datasets (e.g., ACM Digital Library, IEEE Explore, etc.) to provide an in-depth analysis. Further, our research did not capture relevant studies published in the second half of 2021 or 2022 to form a more complete picture since it was conducted in June 2021. Future research may cover more updated studies for a comprehensive analysis. Our review used citation counts as the criteria to identify the representative articles; however, the citation counts are only one indicator of research impact (Chen et al., 2021); future research could use other indicators (e.g., H-index and average per citation count, etc.) for representative article analysis.

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