



## RESEARCH ARTICLE



## A LITERATURE REVIEW OF THE OPPORTUNITIES AND BARRIERS IN COMPUTER-ASSISTED LANGUAGE LEARNING (CALL)

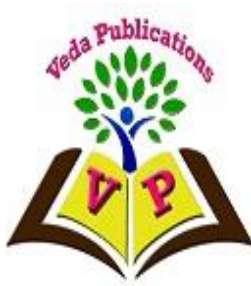
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### ABSTRACT



The use of computers in language instruction has been a topic of research interest since the 1960s. The following literature review gives an overview of how Computer-assisted language learning (CALL) has evolved from mainframe-based drill and practice programs to NLP-based conversational agents that function as language tutors. Further, the review examines the economic, logistic, and technical to adopting CALL. Ultimately, the review sheds light on the new opportunities presented to CALL to overcome the barriers, primarily owing to advancements in the field of adaptive learning and testing and Natural Language Processing. The following research questions have guided the literature review:

How has CALL developed over the years?

What are the barriers to CALL?

What are the new opportunities in CALL?

**Keywords:** *Language Learning, Computer-Assisted Language Learning, Computer-mediated communication, Natural Language Processing, Technology-Enhanced Language Learning*



## INTRODUCTION TO CALL

According to Ken Beatty (2003), the working definition of Computer-assisted language learning (CALL) is: "any process in which a learner uses a computer and, as a result, improves his or her language." This definition covers a broad range of computer-related disciplines under its fold: 1. Computer-aided instruction (CAI), 2. Computer-assisted learning (CAL), 3. Computer-assisted language instruction (CALI), 4. Computer-assisted language teaching (or testing) (CALT), 5. Computer adaptive teaching (or testing) (CAT) and 6. Computer-mediated communication (CMC).

According to Levy (1997), a useful way to conceptualise the field of CALL is to divide it according to the functional role played by the computer- as a tutor and as a tool. He made the distinction between the two roles using an example- "A vocabulary flashcard program or a set of online grammar exercises would represent tutor uses, where the computer in some way has an overt teaching function. A language learning activity involving social media, an email program, or a web search engine like Google would represent tool uses, where the computer has no overt teaching function." (Levy, 1997)

## CALL AS A BEHAVIOURIST TUTOR

Until the late 1970s, CALL projects were confined mainly to drill and practice programs developed on large mainframe computers in universities. (PLATO project; Marty 1981). The main aim of drill-and-practice programs was to review the content/background knowledge and assist the learners in mastering separate language skills (such

as reading, listening, etc) using exercises such as paired-associate, sentence completion, and multiple-choice, part identification, true-false, and short-answer questions. (Beatty, 2003) Since this application of CALL was based on the behaviourist learning model (a model based on repetitive drills), it was termed as behaviourist CALL.

After the mainframe-based programs, the spread of the microcomputer into educational settings in the early 1980s led to early programs written by teacher-developers on Apple II, IBM PC, and BBC computers. These programs/software presented the content of the lessons as text, graphics, video, animation, and slides, and also included learning activities and drills for practice. (Hubbard, 2021). 'Oxford Advanced Learner's Dictionary', 'Learn to Speak English', 'Memrise' and 'Rosetta Stone' were examples of such language learning software. These software were intended as comprehensive language learning solutions. In other words, students should have been able to learn the language by engaging with the content provided by these software without attending any student-teacher interaction or a face-to-face class. (Beatty, 2003)

However, research from Hanum (2004) and Nielsen (2011) indicates that students need direct interaction with teachers too to learn a new language. Therefore, language instructors have successfully implemented blended learning solutions, in which students meet regularly in projector/computer-equipped classrooms with the instructor and work their way through web-based activities and live sessions. (Rui, 2022)

**SHIFT FROM BEHAVIOURIST TO CONSTRUCTIVIST CALL**

Research from Richards and Rodgets (2001) documents that behaviourist approaches to language learning started to get challenged in the late 1970s. According to Stevens (1989), the popularity of behaviourist CALL declined because it tended to focus overly on the details and the surface forms of the language at the expense of real-world communication. On the contrary, a new emerging model of CALL called the constructivist model focused on the learners constructing the knowledge from their experiences rather than just passively taking it in. Here, the teacher's role was to aid the learner in this construction by providing support in the form of modelling, coaching, and scaffolding, rather than simply providing the information to her or him (Bowers et al., 2010). Scholars believe that the proliferation of electronic media has become the paradigm to promote student-centred learning where teachers function as facilitators and guides. (Rani, 2014)

However, it is worth stating that despite the fall of the behaviourist model, programmed instruction continues to be common in CALL, especially for vocabulary study and grammar practice in the classroom. (Fotos and Browne, 2004) The reason for behaviourist CALL's enduring appeal may simply be that programmed instruction is an easy-if not ideal—thing for the computer to do. Today, the popular use of such programs is in teaching learners how to pass standardized tests. (Hubbard, 2021)

**SHIFT TO INTEGRATIVE CALL**

Unlike behaviourist CALL which tended to focus on separate drills for the mastery of each language skill (listening, speaking, writing, and reading), integrative CALL seeks to integrate the various skills of language learning through the method of task-based learning. (Warschauer & Healey, 1998). Research from Robert Blake- which indicates that isolating each of the four skills (listening, speaking, reading, and writing) in practice is no longer as relevant as it was historically, given the contemporary views of integrated language development- agrees with the shift to integrative CALL. The forthcoming sections on "Gamifying Language Learning" and "CALL as a Tool" focus on the Constructivist and the Integrative model of CALL.

**GAMIFYING LANGUAGE LEARNING: A REVIEW OF "WHO IS OSCAR LAKE?" AND DUOLINGO**

Language learning can be challenging and anxiety-inducing (Akbari, 2015). Research from Reece & Walker (1997) states that motivation is a key factor for achieving success in the language learning process. This is where the need to gamify language learning arises. According to Kapp (2012), "gamification involves using game-based mechanics, aesthetics, and game thinking to engage people, motivate action, promote learning, and solve problems". Research from Castañeda and Cho (2016) is in agreement with this definition as it has pointed out that game-like elements present a motivating environment that can increase language accuracy and confidence. To understand gamified language learning better, the review sheds light on the role of 2 game-based CALL software- "Who is Oscar Lake?"



and Duolingo.

“Who is Oscar Lake?” is a CD-ROM-based mystery game in which the language learner has been framed for the theft of a diamond and has to go to a foreign city (featuring the target language) and use clues and interviews to trace the thief. (ESL, n.d.) The pace of the game is controlled by the learner, and different choices change the plot line. While playing the game, the learner learns the language as a peripheral activity to solving the mystery. (Borges, 2014) Online dictionaries and translations with sound are available if needed. This game is different from behaviourist programs due to the absence of repetitive drills or endless vocabulary lists here. (ESL, n.d.) Instead, the game is based on language immersion, according to Kozlova (2021), the most effective way to learn a second language.

The next software under review is Duolingo. Duolingo is a language learning app that shows the characteristics of both, a behaviouristic and constructivist tutor- the app provides the learner with a series of repetitive exercises where the learner acquires the language with trial and error (behaviourism) and also provides the feature of a leaderboard and a placement test (constructivist concepts of social interaction and scaffolding respectively). (Volpi, 2020) Research from Fadda and Alaudan (2020) and Garcia (2013) confirm that these are the driving factors behind Duolingo's success in promoting the learners' language proficiency.

#### **CALL AS A TOOL**

According to Levy (1997), the computer can act as a tutor or a tool. The above section discussed CALL's role as a tutor. Computer-assisted language

learning tools are based on the constructivist theory of language learning- which is based on learning grammar and syntactic structure implicitly through experiences from secondary tasks. (Suhendi & Purwarno, 2018). As a tool, a CALL program works as an aid to a teacher in the language learning situation without delivering any explicit instruction. (Levy, 1997). The following section of the review delves into some of the applications of CALL as a tool- 1) Computer-Mediated Communication (CMC), 2) Word Processors and Automated written corrective feedback (AWCF) tools, and 3) Machine Translation.

The mainstreaming of Computer-Mediated Communication (CMC) is a major factor behind the rising popularity of CALL as a tool. In CMC, “computers are a means through which teachers communicate with learners, learners communicate with one another and learners may even communicate with native speakers through channels like text, voice, video.” (Hubbard, 2021). For instance, email, a source of asynchronous communication can be used by the students to communicate among themselves or with a foreigner EPal, improving their language proficiency in the process. (Beatty, 2003) Some use-cases of CMC for language learning can also make use of multiple mediums simultaneously, this is termed ‘multimodal CMC’ (Hampel & Hauck, 2006). For instance, learners can use the chatbox to share text messages and images on a Zoom call. Hubbard (2021) notes that one of the great advantages of CMC over tutorial CALL is the familiarity of the teachers and the learners with the relevant communication tools and the high availability of these tools which makes it much easier to integrate CMC into classes. However, he also notes



that it is crucial to- 1) introduce a CMC exercise thoughtfully in the class, 2) give the learners appropriate training in the technology and, 3) link their actions to the language learning objectives of the course.

The next set of tools under consideration are word processors, and automated written corrective feedback tools. Windeatt (2019) has offered compelling arguments supporting the use of word processors like MS Word, Google Docs, etc. in language learning, citing the powerful editing facilities that can encourage the learners in the process of forming, testing and refining hypotheses about the target language. "Learners are, on the whole, reluctant to try out alternative versions of written work or to produce revised and corrected drafts to take account of feedback, simply because of the amount of work involved in producing these revised versions. Once the facilities offered by a word processor have been mastered, however, the economy of effort involved in editing text is likely to encourage both the initial production and later revision of written work, and in this way foster the process of forming and testing hypotheses about the language", the paper from Windeatt (2019) stated. Separate research from Ranalli and Yamashita (2022) on Automated written corrective feedback tools like Grammarly shows that L2 (Second-language) student writers stand to benefit from enhanced error-correction capabilities of AWCF tools, given that they can toggle the corrective feedback (CF) on and off based on the learning objective at hand.

Finally, the review highlights the role of machine translation (MT) as a CALL tool. According to Jurasfky and Martin (2021), "Machine translation

(MT) is the use of computers to translate [documents] from one language to another." Findings from research by Ata and Debreli (2021) found that a substantial proportion of language learners used MT tools for reading and writing assignments. However, the promise of MT for language learning cannot be generalised to all language learners as a study on using MT as a CALL tool for language learners at varying levels of proficiency conducted by Garcia and Pena (2011) suggested that MT can be proven to be of substantial help to mostly the beginner and intermediate language learners (lower proficiency). In addition to the language learners, language instructors have also reacted positively to the use of MT for language learning as can be concluded from an interview with Marty Abbott (Lynn, 2016), the executive director of the American Council on the Teaching of Foreign Language, where she commented that technologies like machine translation have proven to be of significant assistance for the teachers. "I think teachers are even using Google Translate with their students to have them analyze why they are accurate or inaccurate. So it really can be a useful tool for teachers in the classroom."

This section of the review attempted to give an overview of the development in the field of CALL. The upcoming section of the review examines the barriers to adopting CALL.

#### **BARRIERS TO CALL**

Research and reviews from Hani (2004), Lee (2000), and Garrett (1991) suggest that there are a number of barriers to the use of CALL in language learning. These barriers can be categorized into- (1)



Economic Barriers, (2) Logistic Barriers, (3) Technical Barriers, (4) Learner Motivation. This section delves into each of these barriers.

#### **Economic Barrier**

Lack of finances has been a recurring theme in the literature related to barriers to Computer-assisted language learning. CALL requires institutions' investment in hardware, software (purchasing a licensed software or developing one from scratch), maintenance of software and faculty training. (Lee, 2000) Research from Herschbach (1994) also claims that CALL will not lower the cost of providing educational services; thus making it an add-on expense. According to a study conducted by Hani (2004), 'high costs' was the fifth most significant barrier in computer-assisted language learning.

#### **Logistic Barrier**

The same study by Hani (2004) showed that unavailability of adequate hardware or/and software is the most significant barrier to CALL. "Choosing hardware is difficult because of the many choices of systems to be used in delivering education, the delivery of equipment, and the rapid changes in technology." (Lee, 2000).

As for software, the absence of high-quality software is the most pressing challenge in delivering language instruction using computers. Underlying this problem is a lack of knowledge of the elements in the software that could promote different kinds of learning, and a scarcity of educators skilled in designing it because software development is costly and time-consuming (McClelland, 1996). The following passages expound on this barrier of software deficiencies by using the particular instance

of obstacles in- 1) gamification, 2) vocabulary-improving software, and 3) automated methods for textual remedial feedback.

Even though gamification is being readily adopted in the language-learning sphere, language-learning games are often formulaic, relying heavily on gimmicks. (Flores, 2015) The two games that were discussed in this review, "Where is Oscar Lake?" and Duolingo, also have some limitations. According to Otto (2017), "Oscar lake while engaging and multilingual proved less beneficial for language learning since the ratio of time spent using the language to the time spent playing was very poor." As for Duolingo, most of its activities are based on behaviourist approaches to language learning (Catania & Harnad, 1988), by encouraging rote learning and rewarding repetitive output. Teske (2017) additionally points out the lack of activities centred on pragmatic or cultural skills in Duolingo can be problematic to instructors teaching from sociocultural perspectives.

Vocabulary-enhancing software for language learners often displays words on a wide range of levels of difficulty, sometimes spanning as many as 15-grade levels within one product. (Stoller & Grabe, 1993). This approach could impede learning for L2 learners for whom learning high-frequency words is often more beneficial than learning rare, or advanced vocabulary. (Stoller & Grabe, 1993).

According to a study by Ranalli and Yamashita (2022) on the performance of automated written corrective feedback tools like Grammar and Microsoft M-NLP, continual student access to corrective feedback without taking into account the



task at hand can reinforce the students' low-level focus on the text, which diverts attention away from higher-level issues in evaluating and revising their work. Dikli (2010) conducted a separate study to investigate the nature of feedback that English as a Second Language (ESL) students received on their writings from an automated essay scoring (AES) system and the language teacher; the study concluded that AES systems are not fully prepared to meet the needs of ESL or English as a Foreign Language (EFL) students due to the long, generic, and redundant feedbacks outputted.

#### **Technical Barrier**

In addition to the lack of software development skills, a lack of technical knowledge among language educators is also a barrier to CALL. Many instructors do not understand how to use the new technologies. (Lee, 2000) This is concerning because the improper use of technologies can negatively affect both the teacher and learner (Office of Technology Assessment, 1995). Furthermore, the lack of technical knowledge is not just a characteristic of the teachers. Research from Winke & Goertler (2008) suggests that a high percentage of today's university students do not have the skills they need to use computers effectively for language learning. This can severely hamper their learning prospects.

#### **LEARNER MOTIVATION**

According to K. Nielsen (2011), a lack of enthusiasm and initiative among language learners, resulting in high attrition rates (56%), is a continual challenge to the effectiveness of CALL. An investigation on self-studying using CALL tools by motivated US Government employees in the

workplace had one major finding: severe attrition, leading to very limited language proficiency gains in only a handful of learners. (K. Nielsen, 2011)

#### **What are the new opportunities in CALL?**

The above sections of the review have highlighted the evolution of Computer-assisted language learning and the barriers to language learning using it. Technology changes from year to year (or even month to month) (Hubbard, 2021) and the same applies to CALL. Therefore, the following section discusses will delve into the new opportunities and avenues in the field of CALL and discuss developments like Mobile-assisted language learning (MALL), Adaptive Learning and Testing, and Deep Learning (Natural Language Processing). Finally, the section sheds some light on digital literacy, a growing area for both language learners and instructors.

#### **MOBILE ASSISTED LANGUAGE LEARNING (MALL)**

Mobile assisted language learning (MALL) refers to learning that takes place through mobile devices like mp3 players, mobile phones, pocket PCs and so on. (Hubbard 2021). High ownership levels, higher portability, lesser cost, and inbuilt peripherals are some of the factors owing to the increasing popularity of MALL. However, these benefits are also paired with interconnected challenges like limited power, storage, and reduced screen sizes. Nevertheless, the benefit of portability still makes MALL an enticing research field and a fashionable channel for language study. (Chinnery, 2006).



### COMPUTER ADAPTIVE LEARNING AND TESTING

Not everybody learns a language at the same pace (Spiro, J., 2013). This calls for greater research in the area of adaptive learning and testing with computers.

Introducing adaptive and intelligent features to a language tutoring system can help in identifying deficiencies in the learner's knowledge and presenting learning materials at a level suitable to his proficiency (Slavuj, Kovačić and Jugo, 2011). Slavuj, Kovačić and Jugo (2011) have given a general description of the architecture of an adaptive e-learning system for language learning based on- "1) determining the level of language competence by employing an adaptive knowledge validation procedure, and 2) systematically supporting learning by guiding learners through the learning domain towards higher proficiency levels." Computerized Adaptive Testing (CAT) refers to automated testing wherein the program adaptively adjusts the level of the test to that of the participant. Wainer et al. (1990) indicated that two of the benefits of CAT over Computer-Based Testing (CBT) are higher efficiency and increased student motivation due to higher levels of interaction provided.

### DEEP LEARNING: REVIEWING LINGUISTIC PARSERS AND CHATBOTS

The previous sections of the review have delved into some Deep Learning Applications that are being used to facilitate language learning in classrooms: Machine Translation, Automated written feedback tools, and adaptive tutors. The following section delves into two additional NLP Applications for language learning- 1) linguistic and grammar

parsers, and (2) chatbots.

Research from Azab et al. (2013), Meurers et al. (2010) and Chinkina et al. (2016) suggest that one of the major applications of NLP in language learning (especially for L2 learners) is the Text Parser tool. It functions as a 'reading assistant' that helps the user notice the linguistic content of the inputted text by highlighting language structures in context and providing the functionality of looking up the meaning of words. (Zilio, Wilkens et al., 2017) Such parsers allow the users to read texts that are interesting according to their own preference while keeping an eye on important information in terms of linguistic structures that are relevant to their process of acquiring a second language. (Zilio, Wilkens et al., 2017)

A Chatbot is a "computer program or an artificial intelligence which carries out conversations through audio or text, and interacts with the users in a particular domain or topic by giving intelligent responses in natural language". (Haristiani, 2019) The use of chatbots as learning assistants is receiving increasing attention in language learning due to their ability to converse with students using natural language. (Huang, Hew et al., 2020) Research from Mayer (2017) suggests that online language learners tend to learn better when the words are presented in a conversational style, further validating the chatbots' utility in language learning. However, can all chatbots be used as 'conversational practice machines'? Dokukina et al. (2020) have stated that for truly conversational interactions, chatbots have to take into account not just a sequence of independent conversational pairs, but a whole discourse context. Therefore, instead of general-





utility chatbots, there is a need for specifically designed bots that can provide a student with mentoring related to specific skills, taking into account his levels of student proficiency, and finally, reward him to stimulate his motivation. An excellent example of such a bot is Mondly, a language learning chatbot that operates as a smartphone-centred software providing lessons in 27 languages. Mondly provides adaptive lessons that encourage users to practice the language they are learning in everyday scenarios—such as ordering in a restaurant (Fryer, Coniam et al., 2020), therefore encouraging learning through play. (Smith & Pellegrini, 2008)

#### DIGITAL LITERACY

Digital Literacy acquisition is a growing area for both language learners and instructors learning to become both critical consumers and skilled producers of language and culture. (Hubbard, 2021). Some of the competencies associated with digital literacy include, but are not limited to- operating licensed CALL software, using word processing software and e-mail clients for drafting written content, searching for relevant and age-appropriate information on web browsers and practising internet safety. (Tabieh et al., 2021). Research from Aguemeka, Chinyere et al. (2020) offers actionable advice for gaining digital literacy- cautious experimentation with open-source software, participation in digital-literacy courses and adoption of digital literacy curriculums in institutions.

#### CONCLUSION

Even after sixty years of its inception, the field of Computer-assisted language learning (CALL) is constantly evolving. This literature review studied the

shift of CALL from a behaviouristic to a constructivist tutor. Accordingly, it reached the conclusion that the field of CALL is leaning toward constructivism (because of the advent of computer-based communication), behaviouristic approach to language learning is still being used across many applications due to the straightforward nature of programmed instruction. Further, the literature review also examined the barriers to language learning using CALL programs, broadly categorising them as 1) economic barriers, 2) logistic barriers, 3) technical barriers, and 4) lack of learner motivation. Finally, the literature review discussed some upcoming sub-fields of CALL which have the potential to mitigate the above-mentioned barriers, and therefore, are a subject of interest to computational linguists, researchers and language instructors: 1) Mobile assisted language learning (MALL), 2) Computer Adaptive Learning and Testing, 3) Deep Learning: Reviewing Linguistic Parsers and Chatbots, 4) Digital literacy.

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