



Technology-Based Review on Computer-Assisted Language Learning: A Chronological Perspective

Revisión tecnológica del aprendizaje de idiomas asistido por ordenador: una perspectiva cronológica

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RESUMEN

El presente artículo aborda la evolución y el avance de las tecnologías del aprendizaje de lenguas asistido por ordenador (CALL por sus siglas en inglés, que corresponden a *Computer-Assisted Language Learning*) desde una perspectiva histórica. Esta revisión de la literatura sobre tecnologías del aprendizaje de lenguas asistido por ordenador comienza con la definición del concepto de CALL y otros términos relacionados, entre los que podemos destacar CAI, CAL, CALI, CALICO, CALT, CAT, CBT, CMC o CMI, para posteriormente analizar las primeras iniciativas de implementación del aprendizaje de lenguas asistido por ordenador en las décadas de 1950 y 1960, avanzando posteriormente a las décadas de las computadoras centrales y las microcomputadoras. En última instancia, se revisan las tecnologías emergentes en el siglo XXI, especialmente tras la irrupción de Internet, donde se presentan el impacto del e-learning, b-learning, las tecnologías de la Web 2.0, las redes sociales e incluso el aprendizaje de lenguas asistido por robots ■

PALABRAS CLAVE

aprendizaje de lenguas asistido por ordenador; CALL; computadoras centrales; microcomputadoras; tecnologías emergentes.

ABSTRACT

The main focus of this paper is on the advancement of technologies in Computer-Assisted Language Learning (CALL) from a historical perspective. The review starts by defining CALL and its related terminology, highlighting the first CALL attempts in 1950s and 1960s, and then moving to other decades of mainframes and microcomputers. At the final step, emerging technologies in 21st century will be reviewed ■

KEYWORDS

Computer-Assisted Language Learning (CALL); Mainframe; Microcomputers; Emerging technologies



1.- Introduction

At the first stage of this comprehensive review, it is necessary to define Computer-Assisted Language Learning (CALL). Beatty (2010) defined CALL as “any progress in which a learner uses a computer and, as a result, improves his or her language” (p. 7). Changing from simple CD-ROMs to virtual reality in computer science shows the evolving nature of computers and technology which made Beatty (2010) to consider CALL as a vague, unstructured discipline. Moreover, the emergence of new literacies like electronic literacy, multimedia literacy, etc. warn teachers and learners to equip themselves with new technologies and literacies to meet the requirements of 21st century citizenship.

It is considered that CALL was first used by Davies and Steel (1981) in a conference paper, and the term was widespread in the UK a year later, in 1982. This same year, Ealing College of Higher Education published the CALL-related newsletter titled “CALLBOARD”. Furthermore, in 1983, TESOL started up CALL Special Interest Group (Kenner, 1996; Stevens, 2003) which was a big move in the field. Although the exact date of the appearance of CALL term is not completely clear (Davies, Otto, & Rüschoff, 2013), different terms are appeared in the literature of applications of technology in pedagogy. *Computer-Aided Instruction* (CAI) refers to learning at the computer in which there is no necessity in language education, also, the word ‘instruction’ refers to a teacher-centered approach. *Computer-Assisted Learning* (CAL) is similar to CAI, but the focus is on learners. *Computer-Assisted Language Instruction* (CALI) was incorporated into the name of the professional association Computer-Assisted Language Instructed Consortium (CALICO).

In contrast to CAI and CALI, the emphasis of *Computer-Assisted Language Learning* (CALL) is on learning rather than instruction, therefore, it is reflecting a student-centered approach rather than a teacher-centered one. *Computer-Assisted Language Teaching* (CALT) is another term which in contrast to CAL emphasizes the teachers. *Computer-Assisted Teaching* (CAT) is learning any subject at the computer. *Computer-Based Training* (CBT) refers to a program used for teaching of some discrete language learning skills. *Computer-Mediated Communication* (CMC) is a computer-based discussion environment in which learners need to communicate with native speakers of the target language. *Computer-Mediated Instruction* (CMI) is the application of some form of computer software or hardware in instruction in which learning takes place when a learner communicate with a distant tutor. Like CAI, instruction in this term shows a

teacher-centered approach. *Intelligent Computer-Assisted Language Learning* (ICALL) is a software-based program which provides learners with customized feedback based on their performances. *Technology-Enhanced Language* (TELL), as an alternative term to CALL which appeared in 1980s, is any applications of technology in the classroom. Finally, *Web-Enhanced Language Learning* (WELL) refers to CALL in which the internet is the medium for instruction.

Several scholars in the field (Davies, 1997; Levy, 1997; Sanders, 1995) tried to review the history of CALL from different perspectives. Warschauer (1996), Warschauer and Healey (1998), Bax (2003) and Rahimpour (2011) reviewed CALL and classified them based on underlying pedagogical and methodological approaches. Fotos and Browne (2004) reviewed the emergence of CALL and its application by considering the historical context of computers together with their changing role in second language (p. 3). Davies, Otto, and Rüschoff (2013) considered both approaches and technology-based devices and programs in CALL. Beatty's (2010) book provides a brief history of CALL from a comparative perspective of behaviourist and constructivist design features. The focus of this review is on the advancement of technologies in the field of CALL from a chronological perspective.

2.- History of CALL

2.1.- Early CALL and Mainframes: 1950s and 1960s

The USA was the pioneer country in early days of CALL. In 1950s, the prominence of teaching language for military purposes in competent and scientific ways led to the application of huge and high-priced mainframes, as the first application of computers in language learning being available at universities. In competition with USSR in Cold War (1945-1991), the first CALL programs were developed at Stanford University, Dartmouth University and the University of Essex in order to teach Russian as a foreign language (Ahmad, Corbett, Rogers, & Sussex, 1985). Among the early mainframe-based programs, which were served as tutor and drillmaster, the PLATO (Hart, 1995) and TICCIT projects (Anderson, 1976; Jones, 1995) were the highest profile ones (Davies, Otto, & Rüschoff, 2013).

Programmed Logic/Learning for Automated Teaching Operations (PLATO) system, developed by the University of Illinois in 1959, was one of the first and most important CALL systems in teaching Russian by using the grammar translation approach (Merrill, Hammons, Vincent, Reynolds, Christensen, &

Tolman, 1996). The main and early focus of PLATO was on translating Russian texts; later, in the early 1970s, Curtin and his colleagues added “grammar explanations, vocabulary drills and other drills and translation tests over a course of 16 lessons requiring 70 hours to complete” (Beatty, 2010, pp. 20-21). Davies, Otto, and Rüschoff (2013) counted different features for the last PLATO system, PLATO IV, such as “the plasma graphics terminals, multimedia capability using a computer-controlled audio device, the touch-screen input option, centralized storage and delivery of large amounts of instructional material and an online community space” (p. 21). As the PLATO presented some up-to-dated features like feedback, spelling and grammar-checkers, it could be called ‘intelligent CALL’ (ICALL).

2.2.- Microcomputers: 1970s and 1980s

Throughout the 1970s and 1980s, high-end mainframe computers were still available for CALL research. In 1972, the University of Texas and Brigham Young University (BYU), in cooperation with Mitre Corporation, started to develop instructional materials for English and Mathematics. To meet this end, they launched ‘Time-shared Interactive Computer Controlled Information Television’ (TICCIT), the mixture of computer and television technologies (Davies, Otto, & Rüschoff, 2013). The innovative aspect of this project was the fact that TICCIT did not prescribe the learner’s pathway (e.g. learners could move freely through the courseware). Moreover, Boyle, Smith and Eckert (1976) developed a computer-based diagnostic test for French language on a mainframe computer (Chapelle, 2001).

Still the US was the dominant country for CALL activities. Olsen’s (1980) report on CAI in foreign languages showed that over 60 language departments from 52 institutions in 24 states were using computers for language education. However, little activity in CALL was reported by Rex Last in the late 1970s at the University of Hull in the UK.

In that decade, one of the main focus of CALL research was on videodisc technology, which enabled computers to go beyond textual exercise. The CALL research stream moved to a smaller and more convenient format called Compact Disk Read-Only Memory (CD-ROM), and then forwarded to DVD – the larger volume media DVD (Beatty, 2010). Bush and Crotty (1991) counted advantages of videodisc in comparison to traditional instruction: a) more meaningful, b) an understandable context with many extralinguistic clues, and c) empower student’s problem-solving skill (pp. 86-87). Macario, Montevideo and Interactive DÍgame were three early examples of videodisc technology (see Gale, 1989).

The 1980s was the shining period of CALL in which many great publications were released (Ahmad, Corbett, Rogers, & Sussex, 1985; Davies & Higgins, 1982; Davies & Higgins, 1985; Higgins & Johns, 1984; Hope, Taylor, & Pusack, 1984; Kenning & Kenning, 1984; Last, 1984). Furthermore, the emergence of microcomputers influenced the position of CALL in that decade, and two professional associations were founded: CALICO in the USA (1982), and EUROCALL in Europe (1986). CALL programs moved from some specific universities and institutes to into primary and secondary schools. The 'Apfeldeutsch' was the first complete CALL package for microcomputers (Williams, Davies, & Williams, 1981).

In 1983, the MIT funded a five-year project in contribution with Digital Equipment Corporation (DEC) and International Business Machines (IBM) called 'The Athena Language-Learning Project (ALLP)' in order to investigate the role of the computer in education (McConnell, 1994). ALLP benefited from UNiversal Interactive eXecutive (UNIX) (or UNiversal Inter-eXchange or UNiversity eXchange) workstations, which were "connected to each other and to textual and visual databases through a Local Area Network (LAN)" (Beatty, 2010, p. 29). Murray, Morgenstern and Furstenberg (1989) indicated three advantages of the ALLP system: 1) the encyclopedic information usually associated with print that can be recalled with the speed of the computer; 2) the extensive models of the language provided by multiple speakers usually associated with television or film materials; and 3) the engagement of interactivity usually associated with more primitive drill-and-practice routines (Murray, Morgenstern, & Furstenberg, 1989, p. 101). Other successful CALL programs in that decade were two videodisc-based simulation projects: *No Recuerdos* and *À la rencontre de Phillippe* (see Beatty, 2010).

In 1984, Apple Computer developed materials authoring program called *HyperCard*. This program was one of the innovations in the Macintosh environment. *HyperCard* was among the first programs which rooted theoretically in hypertext and hypermedia capabilities, in which text, images, audio, animations and video can be added to a set of virtual index cards (Beatty, 2010).

In the mid of 1980s, ICALL started to show off in CLEF (1985) and TUCO II programs (Taylor, 1987). These programs provided learners with "extensive tutorial sequences, discrete error analysis and feedback" (Davies, Otto, & Rüschoff, 2013). Applying artificial intelligence (AI), semantic and syntactic parsers, natural language processing (NLP) in combination with microcomputers and shifting from drill-and-

practice to communicative competence led to the development of the Spanish game *Juegos Comunicativos* (Bassein & Underwood, 1985) and the German game *Spion* (Sanders & Sanders, 1995). The production of text-only simulations (i.e. Granville: The Prize Holiday Package, Cambridge University Press, 1986; London Adventure, British Council and Cambridge University Press, 1986) is another development in CALL software. The advent of Information and Communication Technology (ICT) in education arouse the use of concordancers in the language classrooms – Data-Driven Learning (DDL). This discovery-oriented approach was a great assist in learning and teaching grammar and vocabulary (Johns & King, 1991).

Davies, Otto and Rüschoff (2013) believed that the major shortcoming of that time was that “microcomputers did not have the capability of recording and playing back sound” (p. 28). To solve the problem, around 1988 and by the advent of sound cards, a new development happened by adapting ‘truly interactive digital sound-enhanced CALL software’ (Davies, Otto, & Rüschoff, p. 29).

2.3.- Multimedia PCs & the Internet: 1990s

CALL development in the 1990s began with the advent of multimedia PCs. This advancement in ICT and computer science changed the face of drill-and-practice programs to more communicative ones. ‘Talking Books’ CD-ROMs became popular by launching the first program *Just Grandma and Me* in 1992 which was the combination of text and sound in three languages. Simulations on CD-ROM such as *Nuevos Destinos* (Blake, McGraw-Hill College & WGBH/ Boston, 1993), and *Who is Oscar Lake?* in 1995 became dominant CALL programs.

CD-ROMs-based programs like *Encounter Series* in 1997, Triple Play (later renamed Smart Start), *Talk to Me* and *Tell me More* series provided different learning opportunities for students by engaging them in listening and responding activities (Davies, Otto, & Rüschoff, 2013).

Davies, Otto, and Rüschoff (2013) believed that the “appearance of World Wide Web is probably the most significant development in ICT during the last 30 years” (p. 31). Natured in drill-and-practice activities, *Hot Potatoes* is an example of web-based interactive authoring tools includes different activities like multiple choice, gap-filling, crosswords, etc. (Arneil & Holmes, 1998-2009).

New terms, tools, and CALL-related developments like ‘e-learning’, ‘online learning’ and virtual learning environments (VLEs) provided with different teaching and learning opportunities both languages teacher and learners, also facilitating teacher-learner and peer-to-peer communication. In the late 1990s, the UK Open University delivered a wide range of courses via Moodle – an open-source VLE. By the development of the Internet and its speed, new applications emerged for language learning and teaching. Among them, Multi-User Domains (MUDs) and Multi-user-domains Object Oriented (MOOs) were two of the most popular ones. To get better understanding, “MUDs were originally designed as text-based, role-playing adventure games to be engaged in across computer networks but they also offered opportunities for collaboration and education, including language learning” (Davies, Otto, & Rüschoff, 2013). Concerning MOOs, language learners (players) log into a MOO and communicate with other learners either synchronously or asynchronously (Shield, 2003; Von der Emde, Schneider, & Kötter, 2001). Virtual worlds or multi-user virtual environment (MUVES) are virtual environments in which language learners act in 3D environments (Sadler & Dooly, 2013; Svenson, 2003).

2.4.- Emerging Technologies: the 21st century

Integration of technology in our 21st-century daily lives has changed the form of CALL programs.

Different commercial entities, governmental and non-governmental entities, universities and institutes began to offer complete language courses on the Internet, as software, mobile applications, etc. Drawback of e-learning led to the coinage of a new term called ‘blended learning’, a combination of both online and face-to-face interactions. Web 2.0 technologies gained popularity from 2004, providing different learning opportunities for language learners through socializing with native speakers of target language via social networking sites and applications like MySpace and Facebook. Web 2.0 is a “social platform for collaboration, knowledge sharing and networking” (Davies, Otto, & Rüschoff, 2013, p. 32). Different web-based communities such as discussion lists, blogs (Yim & Warschauer, 2017), wikis (Wang, 2014), podcasts (Thomas, 2009), vodcasst (Sadeghi & Ghorbani, 2017), social networking sites (SNS), and social media tools (Barnes, 2017; Chen, 2013), among others, are the consequence of web 2.0 technology.

Recently, the advent of mobile and portable devices like smartphones and laptops, and the widespread availability of them has led to the coinage of a new term called Mobile-Assisted Language Learning (MALL). Although some scholars believed that MALL differs from CALL (Kukulska-Hulme & Shield,

2008), the authors of this paper see MALL as a subcategory of CALL. A good number of studies showed the usefulness and effectiveness of portable devices in language learning and teaching: mobile phones (Xu & Peng, 2017), tablet PCs (Chen, Carger, & Smith, 2017), and MP3 players (Demouy & Kukulska-Hulme, 2010), etc. Moreover, different applications of mobile phones functions and capabilities are also reported by different scholars: video recording (Gromik, 2012), GPS (Sandberg, Maris, & de Geus, 2011), QR (Quick Response) codes (Rivers, 2009), short message system (SMS) (Kennedy & Levy, 2008). In spite of the affordances of MALL (Reinders & White, 2010), some challenges and limitations are also reported (Reinders & Hubbard, 2013).

Finally, emerging technologies like new gaming platforms, including massively multiplayer online role-playing games (MMORPGs) (Sourmelis, Ioannou, & Zaphiris, 2017), virtual realities (Badilla Quintana, Vera Sagredo, & Lytras, 2017), second life (Melchor-Couto, 2017; Akayoglu & Seferoglu, 2017), robot-assisted language learning (RALL) (Han, 2012, Fridin & Belokopytov, 2014; Tafazoli & Gómez Parra, 2017) are other new dimensions of CALL faces.

3.- Conclusion

There is no doubt that Information and Communication Technologies (ICT) impact on the way languages are being taught and learned. It can now be argued that Computer-Assisted Language Learning (CALL) is a middle-aged multidisciplinary field with a lot of experiences from different parts of the world (Warschauer, 2013). In view of the advancement, it can be said that CALL has reached the stage of stability in language education; moreover, using language education software and applications have become a common social phenomenon. In order to plan and implement technology successfully in language education classes, however, teachers and learners should clarify their goals. In addition, all the complexities and difficulties, e.g. cultural, structural and infrastructural, of integration of education into syllabus should be considered (Warschauer & Whittaker, 1997). Finally, we would like to warn both language teachers and learners about the ‘technology’s double face’ (Saeedi, 2013). We should consider that, CALL as a pedagogical phenomenon has its own merits and demerits. Language teachers and learners should avoid ‘technocentrism’. As Papert (1987) put it “when we talk about computers in education, we should not think about a machine having an effect. We should be talking about the opportunity offered us” (p. 22).

References

- Ahmad, K., Corbett, G., Rogers, M., & Sussex, R. (1985). *Computers, Language Learning and Language Teaching*. Cambridge: Cambridge University Press.
- Akayoglu, S., & Seferoglu, G. (2017). Social presence functions in task-based language activities in a virtual classroom in second life. In D. Tafazoli & M. Romero (Eds.), *Multiculturalism and technology-enhanced language learning* (pp. 180-197). Hershey, PA: IGI Global.
- Anderson, S. J. (1976, October). TICCIT Project. Paper presented at the National Association of Educational Broadcasters, Chicago, Illinois. ERIC Document No. ED134226.
- Arneil, S., & Holmes, M. (1998–2009). *Hot Potatoes*. Victoria, British Columbia: University of Victoria and Half-Baked Software, Inc.
- Badilla, M. G., Vera, A., & Lytras, M. D. (2017). Pre-service teachers' skills and perceptions about the use of virtual learning environments to improve teaching and learning. *Behaviour & Information Technology*, 36(6) 1-14.
- Barnes, M. (2017). Encouraging communication through the use of educational social media tools. In D. Tafazoli & M. Romero (Eds.), *Multiculturalism and technology-enhanced language learning* (pp. 1-12). Hershey, PA: IGI Global.
- Bassein, R., & Underwood, J. (1985). *Juegos Comunicativos: Games for communicative practice in Spanish, based on Puntos de Partida*. New York: Random House.
- Bax, S. (2003). CALL – past, present and future. *System*, 31(1), 13–28.
- Beatty, K. (2010). *Teaching and researching computer-assisted language learning* (2nd ed.). London: Pearson Education Limited.
- Blake, R., McGraw-Hill College & WGBH/Boston. (1993). *Nuevos Destinos CD-ROM*. Boston, MA / WGBH Educational Foundation and Washington, DC: Corporation for Public Broadcasting.
- Boyle, T. A., Smith, W. F. & Eckert, R. G. (1976). Computer-mediated testing: A branched program achievement test. *Modern Language Journal*, 60, 428-440.

- Bush, M. D. & Crotty, J. (1991). Interactive videodisc in language teaching. In W. F. Smith (Ed.), *Modern Technology in Foreign Language Education: Applications and Projects* (pp. 75-96). Lincolnwood, IL: National Textbook Co.
- Chapelle, C. A. (2001). *Computer applications in second language acquisition: Foundations for teaching, testing and research*. Cambridge: Cambridge University Press.
- Chen, X.-B. (2013). Tablets for informal language learning: Student usage and attitudes. *Language Learning & Technology*, 17(1), 20-36.
- Chen, Y., Carger, C. L., & Smith, T. J. (2017). Mobile-assisted narrative writing practice for young English language learners from a funds of knowledge approach. *Language Learning & Technology*, 21(1), 28-41.
- College, H. (1986). *Granville: The Prize Holiday Package*. Cambridge: Cambridge University Press.
- Davies, G. (1997). Lessons from the past, lessons for the future: 20 years of CALL. In A-K. Korsvold & B. Rüschoff (Eds.), *New technologies in language learning and teaching* (pp. 27-52). Strasbourg: Council of Europe.
- Davies, G., & Higgins, J. (1982). *Computers, language and language learning*. London: CILT.
- Davies, G., & Higgins, J. (1985). *Using computers in language learning: A teacher's guide*. London: CILT.
- Davies, G., Otto, S. E. K. & Rüschoff, B. (2013). Historical perspectives on CALL. In M. Thomas, H. Reinders & M. Warschauer (Eds.), *Contemporary computer-assisted language learning* (pp. 19-38). London & New York: Bloomsbury Academic.
- Davies, G., & Steel, D. (1981, April). *First steps in computer-assisted language learning at Ealing College of Higher Education*. Paper presented at the CAL 81 Symposium, University of Leeds. Retrieved from www.ict4lt.org/en/Davies_Steel_1981.doc.
- Demouy, V., & Kukulka-Hulme, A. (2010). On the spot: Using mobile devices for listening and speaking practice on a French language programme. *Open Learning*, 25(3), 217-32.

- Fotos, S., & Browne, C. (2004). The development of CALL and current options. In S. Fotos and C. Browne (Eds.), *New perspectives on CALL for second language classrooms* (pp. 3-14). Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Fridin, M., & Belokopytov, M. (2014). Acceptance of socially assistive humanoid robot by preschool and elementary school teachers. *Computers in Human Behavior*, *33*, 23-31.
- Gale, L.E. (1989). Macario, Montevideo, and Interactive Dígame: developing interactive video for language instruction. In W. F. Smith (Ed.), *Modern Technology in Foreign Language Education: Applications and Projects* (pp. 235-248). Lincolnwood, IL: National Textbook.
- Gromik, N. (2012). Cell phone video recording feature as a language learning tool: A case study. *Computers & Education*, *58*(1), 223-230.
- Han, J. (2012). Robot assisted language learning. *Language Learning & Technology*, *16*(3), 1-9.
- Hamilton, T. (1986). *London Adventure*. Cambridge: The British Council / Cambridge University Press.
- Hart, R. S. (1995). The Illinois PLATO foreign languages project. In R. Sanders (Ed.), *Thirty years of computer-assisted language instruction: Festschrift for John R. Russell*, *CALICO Journal*, *12*(4), 15-37.
- Higgins, J., & Johns, T. (1984). *Computers in language learning*. London: Collins.
- Hope, G. R., Taylor, H. F., & Pusack, J. P. (1984). *Using computers in teaching foreign languages*. Washington, DC: Center for Applied Linguistics and Harcourt Brace Jovanovich, Inc.
- Johns, T., & King, P. (Eds.) (1991). *Classroom Concordancing*, *English Language Research Journal*, *4*(Special Issue). Birmingham: University of Birmingham.
- Jones, R. L. (1995). TICCIT and CLIPS: The early years. In R. Sanders (Ed.), *Thirty years of computer-assisted language instruction: Festschrift for John R. Russell*, *CALICO Journal*, *12*(4), 84-96.
- Kennedy, C., & Levy, M. (2008). L'italiano al telefonino: Using SMS to support beginners' language learning. *ReCALL*, *20*(3), 315-330.

- Kenner, R. (1996). A short history of the founding of the CALL-IS Interest Section, The CALL Interest Section: Community History, Montreal. Retrieved from http://rogerkenner.ca/Gallery/CALL_IS/founding.htm
- Kenning, M., & Kenning, M.-M. (1984). *An introduction to computer-assisted language teaching*. Oxford: Oxford University Press.
- Kukulska-Hulme, A., & Shield, L. (2008). An overview of mobile assisted language learning: From content delivery to supported collaboration and interaction. *ReCALL*, 20(3), 271-289.
- Last, R. (1984). *Language teaching and the microcomputer*. Oxford: Blackwell.
- Levy, M. (1997). *CALL: Context and conceptualisation*. Oxford: Oxford University Press.
- McConnell, D. (1994). *Implementing Computer Supported Cooperative Learning*. London: Kogan Page.
- Melchor-Couto, S. (2017). Foreign language anxiety levels in Second Life oral interaction. *ReCALL*, 29(1), 99-119.
- Merrill, P. F., Hammons, K., Vincent, B. R., Reynolds, P. L., Christensen, L., & Tolman, M. N. (1996). *Computers in education*. Boston, MA: Allyn and Bacon.
- Murray, J., Morgenstern, D. & Furstenberg, G. (1989). The Athena language learning project: Design issues for the next generation of computer-based language learning tools. In W.F. Smith (Ed.), *Modern Technology in Foreign Language Education: Applications and Projects* (pp. 97-118). Lincolnwood, IL: National Textbook Co.
- Olsen, S. (1980). Foreign language departments and computer-assisted instruction: A survey. *The Modern Language Journal*, 64(3), 341-349.
- Papert, S. (1987). Computer criticism vs technocentric thinking. *Educational Researcher*, 16, 22-30.
- Rahimpour, M. (2011). Computer Assisted Language Learning (CALL). *International Journal of Technology & Distance Learning*, 8(1), 3-10.

- Reinders, H. & Hubbard, P. (2013). CALL and learner autonomy: Affordances and constraints. In M. Thomas, H. Reinders, & M. Warschauer (Eds.), *Contemporary computer assisted language learning* (pp. 359-375). London: Continuum Books.
- Reinders, H. & White, C. (2010). The theory and practice of technology in materials development and task design. In Harwood, N. (Ed.), *Materials in ELT: Theory and practice*, (pp. 58-80). Cambridge: Cambridge University Press.
- Rivers, D. (2009). Utilizing the quick response (QR) code within a Japanese EFL environment. *The JALT CALL Journal*, 5(2), 15-28.
- Sadeghi, A. R., & Ghorbani, S. (2017). The impact of TED-vodcast on Iranian EFL learners' academic oral proficiency. In D. Tafazoli & M. Romero (Eds.), *Multiculturalism and technology-enhanced language learning* (pp. 79-95). Hershey, PA: IGI Global.
- Sadler, R., & Dooly, M. (2013). Language learning in virtual worlds: Research and practice. In M. Thomas, H. Reinders & M. Warschauer (Eds.), *Contemporary computer-assisted language learning* (pp. 159-182). London & New York: Bloomsbury Academic.
- Saeedi, Z. (2013). Care with computer assisted language learning. In D. Tafazoli, & Chirimbu, S. (Eds.), *Language & technology: Computer assisted language learning* (pp. 40-47). Iran, Tehran: Khate Sefid Press.
- Sandberg, J., Maris, M., & de Geus, K. (2011). Mobile English learning: An evidence-based study with fifth graders. *Computers & Education*, 57, 1134-1347.
- Sanders, R. (Ed.) (1995). Thirty years of computer-assisted language instruction: Festschrift for John R. Russell, *CALICO Journal*, 12(4). 6-14
- Sanders, R., & Sanders, A. (1995). History of an AI spy game: Spion. In R. Sanders (Ed.), Thirty years of Computer-Assisted Language Instruction: Festschrift for John R. Russell, *CALICO Journal*, 12(4), 114-127.
- Shield, L. (2003). MOO as a language learning tool. In U. Felix (Ed.), *Language learning online: Towards best practice* (pp. 97-122). Lisse: Swets and Zeitlinger.

- Sourmelis, T., Ioannou, A., & Zaphiris, P. (2017). Massively Multiplayer Online Role Playing Games (MMORPGs) and the 21st century skills: A comprehensive research review from 2010 to 2016. *Computers in Human Behavior*, 67, 41-48.
- Stevens, V. (2003). *How the TESOL CALL Interest Section began*. Retrieved from www.vancestevens.com/papers/tesol/newsletter/callis_began.htm
- Svensson, P. (2003). Virtual worlds as arenas for language learning. In U. Felix (Ed.), *Language learning online: Towards best practice* (pp. 123-146). Lisse: Swets and Zeitlinger.
- Tafazoli, D., & Gómez Parra, M. E. (In Press). Robot-assisted language learning: Artificial intelligence in second language acquisition. In F. Nassiri-Mofakham (Ed.), *Current and Future Developments in Artificial Intelligence* (pp. 370-396). Sharjah, UAE: Bentham Science Publishers.
- Taylor, H. (1987). *TUCO II*. New York: Gessler Educational Software. Based on earlier programs developed by H. Taylor and W. Haas at Ohio State University in the 1970s: DECU (*Deutscher Computerunterricht*) and TUCO (*Tutorial Computer*).
- Thomas, M. (Ed.) (2009). *Handbook of research on Web 2.0 and second language learning*. Hershey, PA: Information Science Reference.
- Von der Emde, S., Schneider, J., & Kötter, M. (2001). Technically speaking: Transforming language learning through virtual learning environments (MOOs). *Modern Language Journal*, 85(2), 210-225.
- Wang, Y-C. (2014). Using wikis to facilitate interaction and collaboration among EFL learners: A social constructivist approach to language teaching. *System*, 42, 383-390.
- Warschauer, M. (1996). Computer-assisted language learning: An introduction. In S. Fotos (Ed.), *Multimedia language teaching* (pp. 3-20). Tokyo: Logos International.
- Warschauer, M. (2013). Foreword: Global communication. In D. Tafazoli, & Chirimbu, S. (Eds.), *Language & technology: Computer assisted language learning* (p. 15). Tehram: Khate Sefid Press.
- Warschauer, M., & Healey, D. (1998). Computers and language learning: An overview. *Language Teaching*, 31, 57-71.

- Warschauer, M., & Whittaker, P. F. (1997). The Internet for English teaching: Guidelines for teachers. *TESL Reporter*, 30(1), 27-33
- Williams, A., Davies, G., & Williams, I. (1981). *Apfeldeutsch*. London: Wida Software.
- Xu, Q., & Peng, H. (2017). Investigating mobile-assisted oral feedback in teaching Chinese as a second language. *Computer Assisted Language Learning*, 30(3-4), 173-182.
- Yim, S., & Warschauer, M. (2017). Web-based collaborative writing in L2 contexts: Methodological insights from text mining. *Language Learning & Technology*, 21(1), 146-165.

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