



New Trends in Second Language Learning and Teaching through the lens of ICT, Networked Learning, and Artificial Intelligence

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Abstract. In the last few decades, Information and Communications Technology (ICT) applications have been shaping the field of Computer Assisted Language Learning (CALL). Mobile Assisted Language Learning (MALL) paved the way for ubiquitous learning. The advent of new technologies in the early 21st century also added a social dimension to ICT that allowed for Networked Learning (NL). Given that language learning is fundamentally a socio-cultural experience, networked learning capabilities have provided the potential for language learning in community settings. This has revitalized the earlier frameworks provided by CALL. NL has empowered language learners today to connect globally, to access Open Educational Resources, and to self-regulate their learning processes beyond the scope of traditional curricula. In parallel, the rising pervasiveness of Artificial Intelligence (AI) applications and their relevance to language learning has led CALL to branch out into Intelligent CALL (ICALL). The first section of this article provides a brief historical overview of CALL, examines it through the lens of ICT, networked learning, and open access. The second section focuses on the implications of AI for creating new trends in second language education, the challenge for providing customization at scale, and raises important issues related to transparency and privacy for future research.

Keywords: Second Language Learning, Second Language Instruction, Computer Assisted Language Learning, Mobile Assisted Language Learning, Networked Learning, Artificial Intelligence.

Contents. 1. Introduction. 2. The role of ICT in language learning. 3. From CALL to MALL and the path to ubiquitous learning. 4. Networked learning. 4.1. Open Educational Resources. 5. The emergence of Artificial Intelligence. 5.1 Early AI and ITS. 5.2 from CALL to ICALL. 5.3 AI and language education - Future Directions. 6. Conclusions. Bibliography.

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1. Introduction

Language learning is fundamentally a socio-cultural experience. In the last few decades, Information and Communications Technology (ICT) integration and applications have shaped how language is taught and learned. The advent of new technologies in the 21st century has also added a social dimension to ICT that allows for what is termed Networked Learning (NL). This has revitalized the earlier frameworks provided by Computer Assisted Language Learning (CALL) and Mobile Assisted Language Learning (MALL). Networked Learning has empowered language learners today to connect globally, access resources openly, and self-regulate their learning processes. Emerging trends are now harnessing these enhanced dimensions of learning.

This chapter will discuss four intersecting areas that are driving change in second language education. Firstly, new technologies have allowed for adaptability, enabling learners to be autonomous, self-paced, and unconstrained by the traditional curriculum. Secondly, networked learning capabilities have shown potential for language learning in community settings. Thirdly, Open Educational Resources have paved the way for distributed expertise and have modified the role of the instructor. Lastly, the rising pervasiveness of Artificial Intelligence tools that use Natural Language Processing (NLP) or Automatic Speech Recognition (ASR) are altering how a second language can be taught and learned. This chapter will discuss these four factors and analyze how they might influence the future of language learning.

In particular, the second half of the chapter focuses on the implications of AI for creating new trends in second language education, the promise and challenge for providing customization at scale, and raises issues of transparency and privacy as they relate to future research.

2. The role of ICT in language learning

Information and Communications Technology (ICT) is the term used mostly in education circles to describe how technology in general is used and applied to teaching and learning. It is not a term specific to language learning, but, as Davis (2011a) points out, the C in ICT signifies the importance that computers play in communication at many different levels, from email to video chat. Communication is central to language learning. In recent decades, ICT has influenced how languages are taught and learned. Within language learning, the most frequently used term is Computer Assisted Language Learning (CALL), which has been its own subject of investigation for the past 30 years (Golonka et al., 2014). Because ICT is a more general term, this paper will focus on CALL.

The use of computers for language learning dates back to the 1960s (Davis, 2011b). The introduction of the audiolingual method, with its insistence on drill and practice, made computer programs ideal companions to language learning (Levy, 1997). Between the 1970s and end of the twentieth century, CALL had a strong influence on language learning. According to Warschauer (2000a), the history of CALL during this period was characterized by three themes: structural CALL, Communicative CALL, and Integrative CALL. Structural CALL during the 1970s and 1980s used computers mainly for drill and practice. Computers played a

very structured role, without much engagement. Accuracy was the main goal for language learning during this period. Communicative CALL in the 1980s and 1990s used computers for building exercises to hone effective communication, It went one step beyond accuracy and also aimed for achieving fluency. Integrative CALL from the 1990s to early 21st was characterized by greater access to multimedia tools and the Internet. Thanks to this enhanced technological access, educators began to design language learning within the classroom in a manner that could be applied even in learning contexts outside of the classroom.

Alternate frameworks of CALL, which chronicle the history of CALL in the last three decades of the 21st century, make a distinction between Restrictive CALL and Open CALL (Bax 2003). In contrast to Warschauer, Bax (2003) offered a different analysis of CALL's development in the last three decades of the 20th century. Given the early behaviorist approach of CALL, in which computer based programs used for learning relied more on rote learning than interactivity, Bax labeled that period as Restrictive CALL. During the 1980s and 1990s, computer programs for language learning allowed students to interact not only with the computers systems for individualized learning, but also with fellow learners. This gradational improvement in how language could be learned in a social context led to the phase of Open CALL. Bax's final phase of Integrated CALL is very similar to Warschauer's interpretation of Integrative CALL. Integrative CALL considered the use of computers as so inherent to language learning that it could be built at the curricular and course level, rather than as an add-on. Just as books are seen as a tool for language learning, without the need to coin a term such as Book Assisted Language Learning, Bax made a case for eliminating the term CALL because of the pervasiveness of computers throughout the field of language education.

The field of CALL continued to influence language learning in the early 21st century. Davies et al. (2013), point out that the field was imbued with the "Web 2.0 fever" of that era. This included the rising of numerous communities using Web 2.0 tools, such as wikis, discussion boards, social networking websites, and virtual worlds. The experiments with virtual worlds in particular took on a life of its own within the language learning community, as evidenced from the creation of several Second Life "worlds" for language learning and, since 2007, conferences known as SLanguages (Davies et. al 2013, p. 34).

Chapelle & Sauro (2017:1) state that "...technology has become integral to the way that most language learners in the world today access materials in their second and foreign language, interact with others, learn in and out of the classroom, and take many language tests." We would also like to add that technology is pervasive in every subject and level in education, and that it is indeed necessary for everyday life. Our students therefore use technology not just to learn a language, but to be better prepared for future challenges. For example, we may use telecollaboration to bring together students from different countries, but those students are also learning how to use tools such as video and chats, which are the tools they will likely use in their own life tasks, for example in remote working scenarios. Technology has allowed us to situate the learner within larger connected networks, and to move away from traditional approaches to teaching. This enables students to take the onus and develop as autonomous learners.

3. From CALL to MALL and the path to ubiquitous learning

A new acronym, Mobile Assisted Language Learning, appeared in the early 2000s with the arrival of mobile technologies. In its most basic definition, O'Malley et al. (2003: 6) describe MALL as “any sort of learning that happens when the learner is not in a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies.” According to the 2018 Pew Research Center data (Pew research, 2018), 77% of the US population own a smartphone, 73% own a desktop or laptop computer, and 53% own a tablet. This rapid change in technology source has also corresponded to changes in how we understand learning. Sharples, et al. (2010) see a clear correspondence between New Learning (personalized, learner-centered, situated, collaborative, ubiquitous, and lifelong) and New Technology (personal, user-centered, mobile, networked, ubiquitous, and durable), both terms coined by the authors. They state that mobile learning “can also be an opportunity to bridge the gulf between formal and experiential learning, opening new possibilities for personal fulfilment and lifelong learning,” (2005: 7) as we are able to move learning outside of the classroom walls and into our everyday lives. With respect to language learning, Kukulska-Hulme et al., 2017, also state that apart from classroom affordability, it is precisely this idea of blurring the lines between formal and lifelong learning that makes mobile learning extremely valuable. They also emphasize that this new type of language learning will require effective learning design, as well as more self-determination on the part of the learners themselves.

Mobile devices have pervaded our everyday lives and created a rich environment for communication through audio, video, and visual text. Nevertheless, instructors need to know how to harness these resources optimally for language learning in an educational context. Some authors (Bozdogan, 2015; Burston, 2015) are legitimately skeptical about the ability of digital tools and apps to strengthen language learning, especially when used in traditional settings with less opportunity for learner autonomy. Much depends on pedagogical intent and task design when using these tools. Positive learning outcomes are possible only when there is strong alignment between the pedagogical goal and the suitability of the technology tool to achieve this goal.

In this context, there are specific projects, such as SO-CALL-ME (Social Ontology-based Cognitively Augmented Language Learning Mobile Environment), which is a part of ATLAS (Artificial Intelligent Techniques for Linguistic ApplicationS), a project from the Universidad Nacional de Educación a Distancia from Spain, as described in Rodriguez-Arancón et al., 2013. These projects take quality criteria into account, combining pedagogical theory with technical criteria. Castrillo et al., 2014, mention that some of the apps developed under SO-CALL-ME are ANT (Audio News Trainer) and VISP (Videoclips for Speaking production). Most of these provide self-evaluation activities as well as auto-correction to make students aware of their improvements and thereby increase their motivation. One more recent example is the app LingroToGo for learning Spanish, developed by the Center for Applied Second Language Science from the University of Oregon. This app combines gaming theory, learning theory, and language pedagogy to build learning materials. These initiatives seem to be experimenting with strategies for building learning-goals-driven models to meet

the educational ends. They are attempts to develop fundamentally new ways to build, share, and self-assess knowledge about languages.

Besides the apps just mentioned, there are many other mobile device programs or apps for studying languages, which were not created for specific classroom use. Rodriguez-Arancón et al., 2013, studied many of these and created a classification system that is useful for understanding learning methodologies. Thus, we have a) games; b) content apps such as dictionaries or textbooks; c) apps for vocabulary, grammar and pronunciation practice; d) adaptation of already existing language courses, such as Rosetta Stone; and e) apps which use the language in context, like Learn Spanish Podcasts.

One category that is very recent, and therefore not covered in the above description, is that of language exchange through the phone or tablet. Two examples are HelloTalk and Tandem Learning, which allow learners to chat and speak with native speakers from other countries. Some of these apps, like HelloTalk, do not even have a desktop equivalent. The only way to use them is through the mobile device.

Finally, of course, mobile language learning also includes real-life apps, since these can be used for authentic language learning. For example, one can use the Twitter or Facebook apps to read native speakers' posts and communicate with them, or listen to the radio from any country where the second language is spoken. One can also watch a TV show on Netflix or shorter clips on YouTube. The important factor for second language learning is how these resources from Netflix or YouTube are used as learner materials, and whether the instructional design is effective in strengthening language learning.

All of these apps have pervaded the language learning field worldwide. Duolingo is a free language learning platform that enables strengthening of vocabulary, grammar, and pronunciation in 28 languages, and has more than 100 million users in 2018. (Usai et.al, 2018). Gamification tools such as Kahoot, which can be applied to any subject matter, including languages, have more than 70 million users and are used actively in foreign language classrooms. (Wang, 2018). Other notable tools with high volume language learning users are the online versions of Rosetta Stone and digital flashcards such as Quizlet. These new technologies signal a radical change in the instructor-learner relationship. Given the easy access to these tools, learners have much more control and can drive how their learning happens, without being directed by the authority figure of a teacher in the classroom. This shift has empowered learners to be more autonomous and to operate digitally within learning communities that go beyond the traditional classroom.

Mobile learning has paved the way for ubiquitous learning. We learn from Jones & Jo (2004) that the term "Ubiquitous Computing was coined by Mark Weiser in the late 1980s and that "it refers to the process of seamlessly integrating computers into the physical world." (p. 468) According to these authors, "students have the freedom to learn within a learning environment which offers adaptability to their individual needs and learning styles, as well as the flexibility of pervasive and unobtrusive computer systems," (p. 469) thanks to mobile devices and the increased capabilities of cloud computing. The work of Gomes (Gomes et. al, 2016) and Ogata and Yaneo (Ogata and Yaneo, 2003) also emphasizes the

pervasiveness of computers as the defining element for ubiquitous learning. Project Hello, developed by Liu (Liu, 2009), uses handheld devices to allow Chinese students to learn how to understand and speak English. This example highlights the potential of mobile tools for ubiquitous learning and the development of learner autonomy. The challenge for the education system, and for instructors in particular, is to develop a pedagogical design for integrating these tools.

Based on this Project Hello work, Liu offers an in-depth comparison between mobile learning and ubiquitous learning, citing nine main differences. Two factors in particular stand out as characteristic of ubiquitous learning. They are 1) the learner's ability to adapt when using multiple devices and 2) the ability to engage in language immersion when using virtual objects, by showing emotional responses that approximate the real-world experience. A 2017 experiment in Turkey with augmented reality for learning also considered ubiquitous learning as an extension to mobile learning and as more effective for an immersive, enriched, situated, and seamless experience. (Bozkurt, 2017).

4. Networked learning

Today we have moved from static computers, which do not communicate with one another, to a plethora of devices, big and small, which allow us to be in touch with each other easily and to belong to different digital networks that expand our everyday connections. Networked Learning (NL), understood in the sense of Jones, 2015, "...learning in which ICT is used to promote connections between one learner and other learners, between learners and tutors, between a learning community and its learning resources" (2015: 5) has therefore emerged as an important paradigm. Within language learning and teaching, Warschauer, already in 2000 coined the term Network Based Language Teaching, with communication being the focus.

Beyond the use of different classroom-based networks, such as those afforded by the Learning Management Systems (LMS) used in many education centers around the world, we will show here three examples of social media tools – Facebook Groups, Twitter and Instagram – and how they can be examples of networked learning for language students. We chose these three because of the high level of usage and how they lend themselves to language learning communities, as compared to other platforms such as Google Plus communities. As of March 2018, Facebook had more than 2.2 billion active users, Twitter had 330 million and Instagram had 800 million, whereas Google Plus had only some 16 million in the year 2015.

Blattner & Fiori (2009) establish that the use of these tools in the language classroom is based upon the ideas of Computer Mediated Communication (CMC), both synchronous (SCMC) and asynchronous (ACMC). Traditionally, assignments of written work "were limited in audience and communicative purpose" and were meant for very a "limited readership." With SCMC and ACMC, however, such written assignments now "expand the intended audience and the range of communicative purpose" through these new dynamic interfaces. Blattner & Fiori also mention the research conducted by Rovai (2002) concerning online learners in a traditional LMS. This research seemed to demonstrate that "a significant relationship exists between classroom community and perceived cognitive learning." Blattner & Fiori (2009) studied Facebook Groups in particular, and the capability they provide for students to utilize authentic language interaction with students from different

linguistic groups in order to develop socio-pragmatic awareness. For Blattner & Fiori, this means “language use in specific contexts, relationship building, and language awareness through observation and/or experience.”

In the case of Twitter, Borau et al., 2009, used Twitter to supplement classroom practice and observed that their Chinese students who were studying English developed a community among themselves (as they had to follow each other on the platform) and also learned from outside sources, improving their communicative competence as well as their intercultural abilities. Instagram, a social network focused on images, can also be used for language learning purposes. One example is the project known as #InstagramELE, as described by Martín Bosque & Munday, 2014. This is an example of Networked Learning with global applications. In the case of #InstagramELE, every month the creators of the project post a list of words or expressions for daily practice. This project is open to any student of the language, at any level. Many instructors have used it with their students, while autonomous learners have also been able to read posts from native speakers, comment on them, and create their own posts. Other instructors have used the tool for classroom activities, such as Al-Ali, 2014, in which students follow each other and post assignments on the platform.

It should also be noted that networked learning does not apply only to students. Second and Foreign Language instructors have embraced social networking sites to create communities of learners for professional development. One example is the use of Twitter by language educators through the #langchat hashtag. This tag is used in two ways. Firstly, every week during the school year, instructors use the hashtag to have a “Twitter chat” about pre-established topics such as a) using more comprehensible input in the classroom or b) how to create your own interactive stories. These chats last one hour. Anyone can participate, and at the end of the session, the moderators archive the topic responses. The hashtag is now also used in general by language educators who want to call attention to something important to the profession. Another noteworthy popular hashtag exclusively for Spanish teachers is #charlae1. Wesely (2013) indicates that such interactions via networked learning have resulted in a community of practice (CoP). In an effective CoP, “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger, 1998; Wenger, 2006:1). A research study by Wesely through surveys and interviews of #langchat participants has shown that this type of professional development helped the teachers collaborate and learn.

Networked Learning and the affordances of the incredible advances in technology are showcased in particular in the case of virtual exchanges, as described here:

virtual exchange involves the engagement of groups of learners in extended periods of online intercultural interaction and collaboration with partners from other cultural contexts or geographical locations as an integrated part of their educational programmes and under the guidance of educators and/or expert facilitators. (O’Dowd, 2018, p. 5)

According to O’Dowd, 2018, there are different approaches to virtual exchanges, from students communicating with other students one-on-one to more class-to-class types of projects, which can involve not just language learning, but other disciplines as well, such as business. Recent examples of how these types of exchanges are

growing, also mentioned by O’Dowd, are those using the COIL model, created by the Center for Collaborative Online International Learning, from the State University of New York. Classrooms around the world connect in order to undertake projects. Although language learning may not be the main purpose, it is often an integral part of the projects conducted.

4.1. Open Educational Resources

The fast-growing trend of Open Educational Resources (OER) has pervaded the Second Language Learning academic domain as well since 2002 (Hylén, 2006). A basic definition of OER is as follows: “Open Educational Resources are digitized materials offered freely and openly for educators, students and self-learners to use and re-use for teaching, learning and research.” (Hylén, 2006). One of the characteristics of OER is that of Networked Learning: the creation of these resources that can be used within a network or can be created by a network of instructors and students. Increased interest in OER is also evident within language learning. Free textbooks are already available for French I and II and Arabic for Global Exchange created by Carnegie University. A German open textbook exists, *Deutsch im Blick* (Abrams, 2017), and there are additional interesting initiatives, such as the creation of The Center for Open Educational Resources and Language Learning (COERLL) by the University of Texas at Austin. COERLL was started in 2011, with the mission to produce and distribute online language courses and materials. They provide learning materials for 18 different languages.

One example of OER resources created by students is the *Antología Abierta de Literatura Hispana* (2017), edited by Ward. Students from her Introduction to Hispanic Literature course selected copyright-free texts from Spanish-speaking authors and added introductions and footnotes to help comprehension, as in any regular anthology of literary texts. In the first edition, they collected the works from nine authors, including Emilia Pardo Bazán, Rubén Darío, and Alfonsina Storni. The project has now been opened to any other Spanish literature class that may want to contribute a work of art from an author who has not yet been covered. Ward has created materials that will enable professors to follow in her footsteps. Students work in groups, select the text they want to explore, and can therefore potentially produce a new chapter for the anthology. Students not only assume agency for their learning, but their classwork also goes beyond the end of the semester, as it will have a real-life application. This type of activity is also connected to Project Based Learning (PBL). From PBL we learn that “the most effective learning occurs when the learning is situated in an authentic, real-world context.” (Krajcik & Blumenfeld, 2006: 319) and when there is social interaction through which teachers, students and community members work together in a situated activity to construct shared understanding.” (2006: 319).

5. The emergence of Artificial Intelligence

5.1. Early AI and ITS

The field of Artificial Intelligence (AI) has come a long way since the emergence of AI research in the 1950s, when Turing developed the famous Turing Test to investigate whether machines could think. Early trends in AI research showed a

philosophical distinction between Weak AI and Strong AI. The view of AI as building systems that can think like humans was called Strong AI. Alternately, allowing systems to work without figuring out the complexities of human thinking was seen as Weak AI (Marr, 2018). Strong AI has been seen as a threatening concept, since it aims to replicate human intelligence and take over control from humans. A half-century hence, the twenty-first century definition of AI has been modified as follows: AI is “a science and a set of computational technologies that are inspired by—but typically operate quite differently from—the ways people use their nervous systems and bodies to sense, learn, reason, and take action.” (Stone et al., 2016). We do not know enough about the complexities of human reasoning to even begin to approximate it via machines. That being said, as research has progressed, it has moved beyond the binary perspectives of Strong and Weak AI. An emerging third objective of AI is to build models based on human reasoning, without the end goal of replicating complex human thinking (Marr, 2018). One such recent development related to this third goal is the “partnership on AI to benefit people and society.” This alliance was cofounded in 2016 by Amazon, Google, IBM, Facebook, and Microsoft to study how AI is being used, and to examine AI’s impact on people and society. (Hern, 2016). By creating an open platform for discussions, this partnership is setting up a sense of transparency for studying the complex influence of AI.

This brief history shows that the AI framework has undergone paradigm shifts in its philosophical approach. With advancements in Natural Language Processing, capabilities for networked learning, and the technological ability to handle massive data, today’s AI has significant applications for language studies in general, and for second language studies in particular.

The focus of AI in language learning can be traced back to the work of Intelligent Tutoring Systems (ITS) in the 1980s and their great promise of personalized education. Early versions of ITS were computer-based learning systems that attempted to adapt to the needs of learners, and were therefore seen as “systems which attempt to ‘care’ about learners in that sense.” (Self, 1998). They were considered significant for individualized learning because the tutoring element that allowed for infinite repetitions and practice had advantages over a human tutor. Despite this intent, a meta-analysis of 39 studies related to 22 types of ITS in higher education revealed that ITSs had only a moderate positive effect on college students’ academic learning (Steenbergen-Hu & Cooper, 2014). This could also be attributed to the limited pedagogical design of the ITS applications. After almost four decades, AI in its more updated version is revitalizing the potential for personalized learning. (Reiland, 2017).

Stanford University released a “100-year report on AI” in 2016. (Stone et al., 2016). By providing historical documentation and envisaging future directions, this report set to investigate eight factors related to AI, including the factor of education. The report presents the following findings related to language learning: while AI showed great promise for language learning, the early work of AI diminished because of its limited ability to promote deep learning in systems such as the ITS. Today, AI has permeated many aspects of everyday lives, from smart applications on our mobile devices to self-driving cars.

Within the field of AI modeling, Natural Language Processing (NLP) has

played a significant role in the development of CALL. One example is the E-Tutor, which used NLP techniques to teach German as a second language. (Heift, 2010). Heift has studied the benefits of using such AI based systems for teaching second languages.

NLP allows for speech-recognition patterns using cell phones. The contribution of AI in this area of language processing has therefore led to wider applications. The algorithms used for speech-understanding on our phones are being applied to many other areas, including web search and healthcare informatics (Stone et al., 2016). The Stanford report states that the work of NLP has included research in reasoning, although scale-up has been challenging because it is usually designed for specific projects. AI work has an array of applications that rely on pattern recognition. Early AI systems could not expand these pattern recognitions to complex scenarios suitable for language learning. Almost eighty percent of the AI advances in the last decade have been attributed to the greater computing power available today. (Hof, 2015).

5.2. From CALL to ICALL

ICALL stands for Intelligent Computer Assisted Language Learning. The recent move from CALL to ICALL has been an inevitable one. Just as CALL led to the new area of MALL with advancements in mobile technology and their applications in language learning, the pervasion of AI has logically evolved to an academic area called ICALL.

The language processing capabilities of Natural Language Processing technologies have myriad applications in computer-assisted language learning (CALL), and the area of research that explores and implements such applications is referred to as intelligent CALL, or ICALL. (Lu, 2018).

Although recent literature has documented the evolution of ICALL as a logical progression from CALL with strong NLP applications, CALL has always been influenced by AI, even during its emergence period. CALL studies in the 1980s were shaped by the ITS framework and catered to the individual learner wanting to strengthen language learning through tutoring systems. The main difference today is that while ITS relied heavily on rote-learning process mechanisms built into the computer-based learning framework, today's application of AI is far more sophisticated, while holding on to the same goal of catering to the individualized learner.

The real development from CALL to ICALL has been the language teaching paradigms that have evolved from simple rote-learning mechanisms to complex language teaching that provides adaptive and connected learning environments. For example, a 2017 case study in ICALL by (Ziegler et al, 2017) has examined the process and outcomes of second language development by highlighting "what learners do during visually enhanced instructional activities." A 2018 study of NLP's applications in ICALL, (Lu, 2018) has broadly categorized the applications into work on the target language, the learner text and the dialogue systems afforded by NLP for meaningful communications.

With such advancements, there is great opportunity for the AI systems to promote customized learning. What has changed radically is the notion of customized learning. Whereas the previous model involved a student working in

isolation using an ITS, students can now work in a networked environment. This situates the learner in learning scenarios that are closer to the reality of fostering language studies in connected social settings.

The AI influence in second language education went through a hiatus in the early 2000s when the MOOC movement took over the experiment of serving learners on a large scale through Open Educational Resources. While the MOOCs offered a much needed alternate model to the high cost of higher education in the US and beyond, they had serious limitations when it came to fostering engagement, promoting peer learning, providing legitimate scaffolding, and reaching global learners on a large scale. These limitations have slowed down the MOOC movement when it comes to providing education on a large scale.

Ongoing MOOC projects such as Khan Academy, EdX, Coursera, and Udacity have employed AI and NLP techniques. This reemergence of AI with its powerful NLP capabilities has a huge impact on second language education. This might be seen as a welcome change because NLP based tutoring systems can give corrective feedback, and can adapt and tailor instructional materials. This has received wide attention in second language scholarly research. The 2017 study by Ziegler et. al, has examined the learning process and outcomes from using ICALL related to visually enhanced instructional activities. (Ziegler et. Al, 2017)

The reactive one-sided ITS systems of the past have now been replaced with interactive machine learning tutors. These machine tutors are being used in many disciplines, including language learning. The Stanford report states that “Natural Language Processing, machine learning, and crowdsourcing have boosted online learning and enabled teachers in higher education to multiply the size of their classrooms while addressing individual students’ learning needs and styles.” Below are some examples of AI applications that are highly relevant to language learning today:

- One of the first AI applications was the Dragon transcription software that transcribed text from speech. Dragon software with speech recognition was integrated with Windows in the 1990s. Use of this Dragon dictation tool has shown benefits for second language learning, particularly related to pronunciation. (Campbell, 2017).
- Downloadable software and online systems such as Carnegie Speech or Duolingo have provided foreign language training using Automatic Speech Recognition (ASR) and NLP techniques. These systems go beyond speech-to-text transcription by recognizing language errors and helping users correct them. This has potential for the promotion of self-regulation and the emergence of learner autonomy.
- Language robots have entered education. A robot L2-TOR (pronounced ‘el tutor’) is a research project funded by the European Commission. It uses social robots for Second Language Tutoring. It is designed to interact naturally with children aged four years old in both the second language and the child’s native language.” (Kanero, J., et al., 2018). This research project is still underway. Although the field of social robotics is important in combining the socio-affective and cognitive aspects of learning, its effectiveness in tutoring children is as yet unclear.

The long promise of greater access and personalization at scale has continued from the early ITS of the 1980s to today. In the current post-MOOC era, higher education is wrestling with best practices to combine face-to-face with AI based online learning. Online learning has become a force multiplier for second language education in reaching students globally. The potential for scaling up appears to be enormous.

AI-based language translation programs such as Google Translate have made great headway in supporting second language and foreign language learners on a large scale. Google Translate supports over 100 languages at various levels, and as of May 2017 serves over 500 million people daily. Given the ubiquitous availability of this translation service, second language learners are tapping into it to augment their learning beyond the classroom.

Machine translation from Google, which uses statistical machine translation rather than grammatical rules, has been severely criticized for accuracy issues, however. More updated versions of Google Translate reported improvements in the level of fluency and accuracy (Turovsky, 2016). Google's switch to Neural Machine Translation is intended to translate whole sentences rather than brief phrases, and is expected to further improve accuracy. What are the implications then for second language teachers and learners? Despite such advancements in translation technology, concerns have also been raised about how the issues of grammatical accuracy in Google Translate could be affecting the learner's process of building proficiency. (Lovett, D. 2018).

AI research has focused predominantly on cognitive processing. Integrating the affective aspects of learning has been a big challenge for the field of AI. In an attempt to confront this challenge, the program *Kismet* was developed in 1997 at MIT as an experiment in affective computing. It made an important breakthrough in the attempt to study emotions. (Breazeal, C., & Aryananda, L., 2002). The *Kismet* robot program aimed to study affective factors such as self-identity, intentionality, and empathy. Since then, there have been encouraging reports of the beneficial effects of computer-aided translation in cross-cultural learning. (Shadiev et al 2018). That said, this is an area of language learning that needs more research. Whether deep learning systems of machine translation can enable a machine to learn a language is the ultimate question.

Current AI research spans many areas, from self-driving cars to health informatics to the Internet of Things. To contextualize AI research within the NLP domain, a brief summary of relevant applications for second language education is presented below.

- Language Teaching: Duolingo, a language learning cloud-based online platform, has been very successful for adaptive learning. It uses Automatic Speech Recognition (ASR) and NLP techniques to teach languages within a networked community. Duolingo is seen as a popular tool for language learning (compared to Busu, Memrise) because it employs a gamification technique. The Duolingo platform has the potential to strengthen motivation by building a competitive learning environment and situating the learner within a learning community. Compared to Busu, Duolingo is free. This AI tech tool is only a partial resource for the autonomous learner, however. Human teachers and social interactions beyond the digital environment are still essential for

mastering a second language. The work by Crowther (Crowther, et al, 2017) indicate that the “the benefit of Duolingo is more likely as a learning support app than as the sole tool for autonomous learning.”

- Language learning methodologies: A new framework of “reinforcement learning” has emerged as the natural byproduct of improved algorithms. As systems attempt to replicate human reasoning, they are able to figure out aspects of language learning (predictive analysis, grammatical rules, frequency of usages) without being taught. AI-based vocabulary development systems such as TextGenome.org are providing language learning opportunities in which students can choose their own path and pace. More and more, learners will be able to take control of their learning. Focus on reinforcement learning has moved AI systems beyond pattern recognition to decision making. Situating language learning using the reinforcement learning framework in real-world contexts can provide language learners with a repertoire of language learning strategies.
- Language learning assessment: AI essentially utilizes big data from users to build adaptive learning. This has implications for education. Benneman, the head of an organization called EruditeAI, claims that data from users is even more precious than revenue, since the data is helping in the creation of more sophisticated algorithms (Wan, 2017). Large online systems such as Duolingo and MOOCs are collecting huge volumes of student data. An examination of these data is expected to inform student learning in terms of student learning objectives, engagement, and outcomes. The Stanford report mentions the Society for Learning Analytics Research (SOLAR), the *Learning Analytics and Knowledge Conference89*, and the *Learning at Scale Conference (L@S)90* as key organizations studying the complexities of student learning. These large datasets can be used to create meaningful assessment mechanisms, but much depends on how these mechanisms are built.

All of these developments in AI have huge implications for language education and raise important questions such as: Will AI improve classroom methodologies? Will it improve efficiency for teachers? Will it make education more accessible? And ultimately, will it replace the teacher? Despite the many forays of AI into education, there is not yet sufficient evidence for the effectiveness of AI-based projects in improving language learning on a large scale.

5.3. AI and Language Education – future directions

The fear of robots taking over jobs and negatively affecting the language learning industry has not died down. AI’s limitations in replicating complex human reasoning have also raised serious issues about the quality of education it can deliver. Academic reports such as the Stanford study, however, have stated that the AI domain is not a threat to mankind and can only strengthen useful applications. There is no denying that human labor, including labor in the field of education, could be affected. ITS and virtual reality applications are expected to permeate education. Much will depend on the objectives and mechanisms that determine the ‘what’ and ‘how’ of delivering second language education.

Developing transparent AI-based systems using large data volumes will be a

challenge. In this age of designing evidence-based practices in higher education, the use of large volumes of student data could be useful. However, the manner in which multitudes of personal data are used for language processing and educational purposes may be in contradiction to the goals of building transparent systems. One factor directly related to transparency is the growing concern about privacy overall. This concern logically extends to sensitive student data. Even within educational research, the use of large datasets without formal student consent can be a huge breach of copyrights and privacy. (Gillard, C., 2018). New AI-related policies need to be formulated.

Innovative practices depend on experimentation and going through iterative processes. For this, instructors need to work with students using new tools. For example, instructors might design tasks using voice recognition tools to practice pronunciation. Integrating tools, collecting learning analytics data, and studying effectiveness for language learning all require student consent. For this, policy formulation needs to strike a balance between promoting experimentation, working with student consent, and achieving transparency. This balance can be difficult to achieve.

Over the coming decades, research will be driven by the question of how best to integrate AI tools such as machine translation, augmented reality, and virtual reality applications by combining AI with face-to-face contexts for optimal learning. Despite these challenges, the potential benefits for language learning in a multicultural society will hopefully outweigh the challenges described above. While there are a number of challenges in applying AI to language learning education within and beyond traditional curricula, the opportunities for teaching to provide customized and open access to all learners are enormous.

6. Conclusions

The current state of second language education has been greatly influenced by the pervasiveness of cloud-based technologies, AI applications, NLP approach, networked communication, Open Educational Resources, and improved access. As discussed, this complex scenario raises many concerns, such as lack of transparency and privacy issues arising from the mining of student data. Nevertheless, we must also recognize the immense potential these new technologies offer for students to take charge of their learning. Second Language Acquisition studies have been examining the development of learner autonomy for several decades. (Little, 2002). New paradigms can be created only by radically altering existing traditions. There is nothing novel about continuing efforts to understand and promote learner autonomy, but the paradigm shift these technological affordances bring to second language education is the ability to address the learner holistically. Little, a leading researcher of learner autonomy, has emphasized the “need for a holistic view of the learner that requires us to engage with the cognitive, metacognitive, affective and social dimensions of language learning and to worry about how they interact with one another.” (Little, 2003).

Availability of technological tools alone cannot ensure the development of autonomy. But the ubiquitousness, openness, and free or low-cost access to today’s technological platforms (such as the popular Duolingo system) have created

unparalleled opportunities for second language learning. The independent learner's challenge is to figure out how to best harness these tools to meet his or her learning goals. In traditional education settings, by contrast, the instructor's pedagogical intent and task-based learning activities determine the meaningful interactions between the cognitive, metacognitive, and socio-affective dimensions of learning.

The use of language learning applications within individualized and connected settings has greatly redefined the instructor's role as an authority. The mode of teaching has now changed to a distributed expertise in which students can digitally connect with native speakers beyond geographical borders to strengthen their learning.

Current AI system capabilities indicate that the promise of personalized education is closer to realization, thanks to the ability to predict and adapt based on massive learner data (Reiland, 2017). Whether this promise can be delivered is yet to be seen. Strategies for overcoming challenges and capitalizing on opportunities will rely heavily on future research in the coming decades.

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