Language teacher preparation for an AI world: A human ecological perspective

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Abstract

This chapter examines the changes in second language (L2) teaching and learning which are accompanying the increasing use of AI tools and services. To appreciate the affordances and limitations of integrating generative AI into language education, teachers and students will need to understand the nature of systems based on large language models. The statistical model used to generate output in such systems validates a usage-based model of language which emphasizes patterns and regularities over rules. However, AI systems have no real-world experience and can produce language that is contextually and socially inappropriate. To use AI tools effectively and ethically, learners will need to develop critical AI literacy. The complex interrelationship of learner, mentor, peers, and AI systems is best understood using a *human* ecological perspective that incorporates the dynamics of the mind-body-environment relationship in educational settings (Levine, 2020). Using AI tools in language learning is an emergent process in which there is active collaboration among human and nonhuman participants. AI integration will necessitate new approaches and methods that accommodate the changing ecology of an AI world. That calls for a relational pedagogy based on contextual technology use rather than on the attributes of a specific AI tool.

Introduction

Artificial intelligence (AI) is not new. Research into how computers could be led to "think" and to understand and produce human language has been going on since the 1950s. New is "generative AI", computer systems able to create original texts, images, audio, or video based on a simple "prompt" or user request. This new wave of AI began with the public release of *ChatGPT* in 2022, a chatbot able to generate lengthy, coherent, and grammatically correct texts of different kinds. This has been followed by other chatbots, as well as image generators such as *DALL-E*. The intense public interest in *ChatGPT* is a result of the speed, versatility, and high quality of its output, with users generating a surprising array of text types and genres, from programming code to sonnets. The ability to generate texts on virtually any subject has led to a great deal of speculation on how this technology will be used in everyday life, in the work world, and particularly in education. The effect on education promises to be profound, most immediately evident in writing assignments, but ultimately across all academic tasks and disciplines.

In this chapter, we will be examining what the availability of generative AI tools and services might mean for aspiring and practicing second language teachers. That will entail examining the nature of generative AI, as having a sense of how such systems work is important in being able to understand and subsequently communicate to students its capabilities as well as its limitations. We will examine how teachers might be guided in the use of AI-based tools. The discussion will necessarily involve theoretical frameworks which help in understanding and using AI, as well as pedagogical approaches that align with those theories. Ecological theories that examine the nature of the relationship between humans and their environment are helpful in understanding the new dynamic of ambient intelligence supplied by AI-based devices and services now emerging.

Among ecological theories, off particular relevance are sociomaterialism, complex dynamic systems, and activity theory. Those theories have in common a rethinking of humans' centrality, as added importance is given to materials and to the context of the learning activity. Ecological theories support a relational pedagogy, which emphasizes relationships and assumes a distributed agency for human cognition. A *human* ecological perspective acknowledges the vital contributing role in cognition and communication played by nonhuman actors, but stresses the essential *social* role played uniquely by humans. In the conclusion

we argue that, given its ubiquity and promise, generative AI will play an important role in language education, making it imperative that language teachers become informed consumers and appropriate implementers of AI tools in a balanced program that emphasizes real human-to-human communication.

The changing face of AI

Computer scientists working initially in the field of AI pursued a quite different approach to implementing language capabilities in computer systems than that which is used in generative AI today. Not surprisingly, AI researchers attempted to instruct computer systems in how human language works by supplying input into features of a particular language, i.e., its syntax, morphological system, and other linguistic characteristics (Piantadosi, 2023). In essence, it was an attempt to have the AI system understand language the way that linguists do. While some progress was made, ultimately the success in terms of natural language processing (NLP) was limited. That was true as well for the attempt to program the system with practical, real-world knowledge, so that the AI would have some sense of how human society and the natural world work (Lenat, 1995).

It turns out that a better approach is simply to provide a tremendous number of examples to an AI system – in this case huge collections of text – and let the system learn from those examples how a particular language works. The language model created in this machine learning process is based on statistical modeling, identifying patterns and regularities. When this process is carried out on an enormous volume of texts, it results in a "large language model" (LLM) that is able to decode text (user input) and search simultaneously through the multiple layers in its artificial "neural network" to find the statistically most appropriate sequencing of words for generating a response. That output occurs not through any real understanding of language and its meaning, but rather through complex calculations and algorithms based on probabilities of interconnections among words, phrases, sentences, and paragraphs.

Language output in AI systems therefore is not generated through knowledge and application of grammar rules, but rather through frequently combined word combinations. In that way, AI systems support usage-based language theories which emphasize "constructions" over rules, that is frequently used, repeated, and varied chunks of language–multiword combinations such as collocations. The language model represented in generative AI "is a clear victory for statistical learning theories of language" (Piantadosi, 2023, p. 18). For language teachers, this can be an important lesson of metalinguistic awareness to transmit to students, namely that language is not based on a set of fixed rules but on frequently combined word groupings. Large language models work so well because they are based on human language as it is actually used, through patterns drawn from collected texts. Making that point in instructed settings could profitably be accompanied by a discussion of corpus linguistics, which has been an area of investigation that has demonstrated the validity of a usage-based approach to understanding human language (Boulton & Cobb, 2017).

Understanding how generative AI models gain their language abilities provides insights into their capabilities, but also into their limitations. These systems are not programmed with the mechanics of how language works or how to write a coherent text, rather machine learning allows AI to build a model on its own. This is radically different from traditional computer processing, where programmers control the process, writing and modifying lines of code to achieve a desired outcome. Traditional computer coding uses symbolic reasoning, based on logical propositions, sequencing loops, and if-then rules. That process and the resulting output are predictable and understood clearly by programmers. This is not the case with generative AI. The general process of how large language models work is understood, but how the output is created through the array of recurrent neural networks is opaque. While computer engineers are able to tinker with LLM systems by providing guidelines and human reinforcement training which can set some parameters on the output, the essential operation of the systems remains an impenetrable black box. The

designers of *ChatGPT* were surprised by some of its capabilities, the fact that it wrote computer code, for example, not something expected.

The reverse side of the machine learning and semi-autonomy of LLM's is that they are fully capable of output that is linguistically acceptable but factually incorrect or socially inappropriate. They have the tendency to "hallucinate", as clearly shown in early user reports of interactions with *ChatGPT*. This derives from the fact that AI systems do not have a genuine understanding of the texts they produce or how those texts might be received by humans. They do their best to accommodate user requests, following directions in the prompts and taking into account previous conversations. They are capable of learning and do improve through usage, including being able to personalize output based on user profiles drawn from previous interactions or other information supplied. But they have no first-hand experience of the world to draw on to judge appropriateness or veracity. Understanding this limitation is important for the development of critical AI literacy, as it relates to how output from AI should be evaluated and used.

A constraint on the communicative effectiveness of AI systems is that they rely exclusively on verbal and written language. Unless AI is built into robots or systems that enable computer vision, these systems will miss the meanings conveyed by humans through gestures, body language, and facial expressions. Human communication is embodied and contextually embedded, according to 4E theory (Ellis, 2019). Gesture and gaze are resources humans use to negotiate meaning, essential to understanding the real import of utterances in conversation (Taguchi, 2021). In fact, pragmatic language use is problematic for AI systems. Although they can learn appropriate language for social interactions (sociopragmatics), such as greetings or requests, actual human interactions are dependent on a host of changing variables, some predictable and under the control of the speaker, others not (pragmalinguistics). Human conversation is contingent and dynamic. For pragmatic behaviors there may be a pattern of usage, but the individual speaker has control over whether to follow those patterns fully, somewhat, or not at all. Human language is based on, but not constrained by patterns; it is an emergentist process (MacWhinney, 2001).

Theoretical orientation: An ecological perspective

Pragmatic language reflects real world usage, that is how language is adapted to the local context. In our world today, that context in many instances will include connectivity to online services. Mobile devices have become ubiquitous companions, something like a "digital appendage" (Godwin-Jones, 2017, p. 4). Home appliances (smart speakers), car interfaces, and wearable devices (smartwatches) are moving us towards an environment of *ambient intelligence*, with microphones, cameras, and sensors collecting and storing data about our daily lives. Personal assistants (*Siri*, *Alexa*, *Google Assistant*) are available from multiple devices and have become trusted sources of information.

While that dynamic has been in development for some time, generative AI has added a new dimension to the human-machine relationship. With the powerful capabilities of these systems, as discussed above, voice assistants are likely to become *personal companions* for many users. One of the striking capabilities of *ChatGPT* is the ability to take on different roles and identities, as directed by the user. That allows the system to imitate the tone and substance of different personas, historical or configured based on a user prompt. Continuously present, voice-activated services will be able to tailor output to individual profiles, supplying more usable search results, personal scheduling, and on-demand conversations on subjects of user interest. This inevitably will lead to a greater dependence on our digital companions, creating a new more intimate human-nonhuman relationship.

To understand the shifting relationship at play in this new environment, a human ecological perspective is needed, which focuses on human activity within the user's context, seen from local (micro), institutional (meso), and societal (macro) levels (Levine, 2020). For language learning, an ecological lens offers a more widely comprehensive view of the process (Chun, 2016), looking beyond the classroom, to

incorporate the variety of resources, human and nonhuman, digital and in-person, accessible to learners today. That brings into consideration all the different scale levels of learning activity as well as semiotic, meaning-making resources beyond verbal language (Hellmich & Vinall, 2021). Among ecological theories, sociomaterialism is particularly informative. This is a framework for analyzing how social forces interact with the material world. Originally used in the biological and social sciences, sociomaterialism has recently also been applied to applied linguistics (Guerrettaz et al., 2021, Thorne et al., 2021), examining the relationship between human cognition and digital tools.

Rather than viewing humans as autonomous agents, sociomaterialism posits a distributed agency shared by humans and nonhumans, with the term *entanglement* being used to describe that relationship. The concept of entanglement references the inseparability of the social and material, emphasizing the essential role of materials in human communication. With AI interactions, that concept of shared agency seems particularly appropriate. In the ways that LLMs use language and in the capacity to learn, generative AI resembles more closely the workings of human brains than is the case with older AI trained on symbolic systems. Indeed, there is speculation that AI may spontaneously develop *theory of mind* abilities, that is, the capability to read cues from language use to impute the mental/emotional state of the interlocutor (Kosinski, 2023).

According to embedded and distributed approaches to human activity, a perspective central to sociomaterialism, cognition is not unique to human brains, but rather is a process that incorporates physicality, whether in the individual or in the immediate surrounding (Thorne et al., 2021). Humans, nonhuman artifacts, and the contextual setting constitute a set of *assemblages* based on "an ecological view of human action as organized by the interplay between persons and resources that are distributed across social and material environments" (Thorne et al., 2021, p. 109). As AI enters the picture, it is clear that the contributing roles in the outcome of the interaction will not be symmetrical nor are they fixed. Instead, each individual interaction will be distinct, in a development that is fluid and variable.

Helping in understanding that process is another ecological framework, complexity theory or complex dynamic systems. That theory, originating in part as chaos theory, proposes that in complex systems, outcomes are unpredictable, based on the nature of initial conditions and on different interactions among actors in the process (Larsen-Freeman, 1997). The variations in learning development and emerging outcomes necessarily move attention away from individual variables in the learning process to how an individual interacts over time with a shifting set of resources, human and nonhuman.

A related framework, activity theory (Engström, 1999), has been used to understand the dynamics of AI use in language learning (Kessler, 2020; Jacob et al., 2023). Activity theory understands learning activities "as a tool-mediated social process" (Chen, 2022). From an activity theory perspective, a learner-agent follows a purpose (writing a text), a process influenced by rules (academic regulations), a community (peer learners/teacher), and a division of labor (separate roles for learner and tool). Jacob et al. (2023) demonstrates the complex process through which a language learner ("Kailing") uses *ChatGPT* to write academic texts in dynamic interactions with peers, AI output, and her own voice and style.

Ecological theories move the analysis from an emphasis on the capabilities of a particular tool, to consider how it is used in relationship to the individual and to the overall language learning environment. That may be best conceptualized through the term "relational pedagogy" (Kern, 2018). That approach pivots away from a primary focus on a particular artefact, such as an AI service, to draw instead a more holistic picture of the contextual relationship of the learner to that entity, as well as to consider other factors in the environment, human and not. Such a pedagogy views technology tools as socially bound, so that an AI interaction can best be understood from considering "the relationship between the human and the computational artifact, at a particular moment in time" (Bearman & Ajjaw, 2023, p. 1163). That is all the more appropriate in that AI represents a "black box" that is only knowable through the output

requested by the user. As suggested above, that output is produced in a process lacking in transparency and uncertain in its reliability. The learner therefore will need to adopt a critical and evaluative relationship to AI output. More generally, pedagogy in an AI world "involves learning to work with opaque, partial and ambiguous situations, which reflect the entangled relationships between people and technologies" (Bearman & Ajjaw, 2023, p. 1160). This is central to critical AI literacy.

That mindset, embracing uncertainty and unpredictable outcomes, will be necessary for teachers to adopt as well. That will represent a challenge for language educators, many of whom likely conceive as language as a fixed entity with a straightforward, linear path to second language development. In fact, in applied linguistics generally (as in other social sciences), the acceptance of an open and relational pedagogy runs counter to the expectations of practitioners "to predict, control, or recommend courses of action to determine situations and outcomes" (Gurney & Demuro, 2022, p. 9). In an AI-infused world, predetermined learning trajectories are unlikely. From a sociomaterial and complex systems perspective, humans are "relationally porous and open systems" (Thorne et al., 2021, p. 109), whose development is dynamic and unpredictable through ongoing interactions with material and social environments. Language teachers will need to accept flexibility in individual learning pathways and variable outcomes. Teacher training should therefore "emphasize recognition and responsiveness over controlled planning" (Guerrettaz et al., 2021, p. 17).

The recognition of individual variation in learner trajectories will need to be accompanied by an appreciation of how varied access to and usage patterns of digital tools and services can be. Issues of cost, infrastructure, and practical time/family/work constraints will lead to unequal access across learner populations. "Basic" (i.e., no cost) access to AI may limit functionality, as companies offer "pro" versions to recoup the enormous cost of AI infrastructures. It is also the case that the "sociotechnical structures" embedded in digital tools (Darvin, 2023) will differentiate interactions: usage patterns, effectiveness, and user perceptions can shift across devices, screens, and platforms. Darvin (2023) has shown how learner interactions with YouTube and other digital services were shaped by factors such as screen size/orientation as software design adapts to different delivery systems. With the advent of multiple avenues for AI access, from PCs to wearables, design and usage factors are likely to impact digital practices and cultures-of-use (Thorne, 2016). Understanding that dynamic will be important for learners' digital literacy, as it will be for teachers. Given the variability in access to AI–and its fast pace of innovation–teachers will need to show responsiveness to divergent individual learning trajectories tied to AI use, tailoring expected outcomes and learning assessments accordingly.

Choosing AI tools for language learning

A major challenge for language educators in integrating AI is the choice of AI-powered tools to use. This will depend largely on the local situation in terms of learning goals, curricular mandates, and technology access. A key aspect of AI integration are teacher attitudes towards the tool in question, which will be shaped by factors such as availability of teacher training/assistance, workload, and teacher profile (experience, age, linguistic ability, etc.). The rapid development in the capabilities of AI systems means that existing L2 learning tools may become no longer viable or cost-effective. Narrowly tailored apps may be replaced by general-purpose AI, which may provide more flexibility in terms of customization and therefore greater adaptability to local needs. In contrast to general tools like *ChatGPT*, technologies like automated writing evaluation (such as *Criterion*), smart text editors (i.e., *Grammarly*), or machine translation (*Google Translate*) represent "narrow AI" in that they target a specific area of language use (Schmidt & Strasser, 2022; see Godwin-Jones, 2023 for an overview).

General AI systems can be configured to provide equivalent functionality through using prompts to instruct the system to provide corrective feedback or even to assess student writing on the basis of an evaluative rubric. Another option is to create a customized version of an AI system to fulfill a specific teaching

or assessing function. Lan and Chen (2024) illustrate that use with a pedagogical agent for English learners that focuses on the use of ordering and transition phrases in narratives. One of the considerations in tool use is the effort (and technical knowledge) needed in creating a custom AI tool, although that process is likely to become more user friendly. It is also the case that traditional narrow AI services my include additional built-in functions that can be helpful to teachers, such as tracing changes at different stages of a student's writing. With the integration of more capable AI, text editors are able to offer expanded writing assistance such as contextual grammatical or lexical explanations. In that way, "narrow AIs are paradoxically holistic language learning (writing) tools" (Schmidt & Strasser, 2022, p. 170).

An AI-based tool universally used by language learners is machine translation (MT), most often *Google Translate*. That functionality is now also available in *ChatGPT* and other major AI systems. MT use has been controversial, as teachers often have both ethical and practical (i.e., learning) reservations about its use. However, contrary to the suspicions teachers may have of whole cloth translation use for assigned writing tasks, studies have shown that the predominant use of MT is looking up single words or phrases (Jolley & Maimone, 2022; Vinall & Hellmich, 2022). A number of studies have examined the use of MT in L2 writing assignments, showing that integration of MT can improve writing quality (Fredholm, 2019; O'Neill, 2019), particularly when that is combined with explicit teacher training in its use.

Tasks integrating MT can focus on different stages of the writing process, from comparing first drafts to MT versions to post-editing machine translated text. Guiding students through the use of MT can help in developing metalinguistic knowledge as well as pointing to the limitations in the capabilities of MT. That might involve showing learners problematic renditions of colloquial or regional expressions. Integrating MT into L2 instruction also enables discussion of the reality of translanguaging (García, O., & Kleifgen, 2020), the co-presence in our minds of all the languages we speak. That can help more students away from a conventional view of human communication, often found in L2 classrooms and textbooks, as being overwhelmingly verbal and fundamentally monolingual.

Language use in context, especially pragmatic use, is another area that can be profitably explored through MT use. Translating exchanges at different levels of formality/familiarity could illustrate sociolinguistic features such as language register. A benefit of introducing MT into the language classroom is the opportunity to compare and contrast lexico-grammatical constructions between languages. This can have the added benefit of providing concrete examples of usage-based language based on chunks (collocations, idiomatic expressions, frame and slot syntactical structures). Hellmich and Vinall (2021) show how teacher beliefs/policies play a central role in the instructional use of MT and how intertwined that factor is with student attitudes, school policies, and instructional goals. The authors evoke complex dynamic systems to characterize the emerging outcomes from the interplay of tools and people interacting across different scales.

If language educators see MT as "cheating", that is likely all the more the case with automatic text generators like *ChatGPT* or Google's *Gemini*. It is no exaggeration to state that the availability of these easy to use and powerful text generators has upended writing assignments in education, just as it promises profound transformations in other domains in which written texts play a central role. Although chatbots based on generative AI represent a giant step forward in NLP, they actually follow a trend already underway through auto-completion technology. That is a feature now widely incorporated into text editors and word processors that use AI to suggest the next word or phrase in a sentence being written. In effect predictive text technology has already provided automatic rewriting at the sentence level. *ChatGPT* takes that to another level by generating lengthy texts and enabling users to supply elaborate prompts that can shape generated texts according to specific instructions. Additionally, *ChatGPT* maintains a record of exchanges allowing users to drill down further in customizing generated texts.

Reports on *ChatGPT* and similar tools point to a variety of roles that such tools can play that can be helpful to learners (Cardona et al., 2023). Language educators have begun to explore options for dealing with generative AI. In fact, since November 2022, many blog posts, YouTube videos, and conference papers have discussed the use of *ChatGPT* for language learning. Shaikh et al. (2023) suggest that *ChatGPT* can help L2 learners through conversational exchanges, translation assistance, and providing grammar and vocabulary-oriented feedback on student writing. Teachers can create lesson plans, learning materials, and assessments, all geared to a particular proficiency level (see Godwin-Jones, 2024). Peer-reviewed articles and practitioner reports on integrating generative AI are appearing (Bonner et al., 2023; Kohnke et al., 2023; Moorhouse, 2024). At the same time, schools and universities world-wide are issuing guidelines for AI, while language teacher organizations offer workshops on integration of AI into language learning and teaching.

Teachers are likely to be concerned that learners will simply turn to AI to produce written homework assignments or to re-write student essays, thus robbing students of L2 learning experiences. However, research into L2 learner use of *ChatGPT* in L2 writing have shown that writers tend to use the tool in various stages of the writing process, rather than simply to generate a complete text (Warschauer et al., 2023). Baek et al. (2023) conducted a survey of student use of *ChatGPT* and found that it was most frequently used by learners to check grammar and word selection.

Warschauer et al. (2023) suggests taking cues from studies of machine translation to inform the use of AI text tools. A strategy in MT studies that can be used in AI is for teachers to use a variety of assigned writing tasks, some of which specifically call for the use of AI, while others avoid its use. That might involve comparing AI and student first drafts, analyzing AI output in terms of contextual appropriateness, or engaging in post-editing. Assignments involving AI are optimally accompanied by ample reflection and discussion of experiences and results, creating greater awareness of systems' capabilities and limitations, thus contributing to the development of critical AI literacy.

The L2 teacher's role: Providing guidance

The availability of automatic text generators—now integrated into a variety of online services—and the dynamics of their use in education, raises difficult issues of attribution and originality, not to mention appropriate instructional use. This is all the more the case as generative AI becomes multimodal. AI tools can now create images from prompts, as well as audio or even video clips that are difficult to distinguish from authentic human voices or representations. Digital fakes seem likely to prove troublesome in education as in other spheres of public life. On the other hand, for language learners, AI-enhanced media may supply valuable learning resources. While not culturally authentic, synthetic voices are fully capable of providing speech in a variety of languages that is nearly indistinguishable from that of expert human speakers.

Voice assistants like *Siri* or *Alexa* are likely to integrate AI more substantially than is currently the case. Those digital tools have already been shown to be useful in language learning (Godwin-Jones, 2023). They will be much more effective conversation partners if they integrate the power of a system like *ChatGPT*. Intelligent agents are certain as well to be integrated into immersive environments. That seems likely to be the case for gaming as well, supplying multilingual and realistic nonplaying characters (Lv, 2023). Generative AI will allow voice bots to move from the traditional closed, scripted functionality to the ability to hold extended exchanges with the user. Added memory capabilities in chatbots will enable user profiles to track conversations, allowing for more meaningful and natural conversations. We have already seen those kinds of personalized, extended exchanges with artificial personas through the use of social bots such as *XioaIce* (Godwin-Jones, 2023).

Given this scenario, what will be the language teacher's role in an AI-infused world? That is likely to be a major topic in teacher education moving forward. Language teachers will need to be aware of AI-enhanced tools that are appropriate for use in instructional settings, but also appreciate the potential of such tools for independent, extramural, and lifelong language learning. One of the common threads in research studies in the use of different AI writing assistants is that student use and learning is optimized through teacher guidance (Ling et al., 2021; Pellet & Myers, 2022). That can entail training students in critical evaluation of AI output. One option for doing that is to use discourse analysis, in an instructor-led practice or through small group work. Chang-Bacon and Pedersen (2023) point out that using discourse analysis in training writing teachers has the "potential to heighten teachers' awareness of their own linguistic practice" (p. 3). Helpful in guiding teacher trainees towards critically evaluating their own potentially unexamined beliefs about writing could be to maintain reflective journals. Studies using a narrative inquiry design have demonstrated how that approach can benefit teachers (Nugrahaeni et al., 2023).

In teacher education programs it is important that teacher trainees gain hands-on experience and reflective opportunities with a variety of AI tools. That might involve not just journaling, but also written or oral reports examining the tool from a practical and pedagogical perspective, leading to class discussion, consensus building, or usefulness rankings of different products and approaches. Having such experiences in training prepares teachers to incorporate those technologies in their own classes. It is worthwhile for teachers to take the time to have students report on tools many of them likely already use, such as *Grammarly* or *Google Translate*. Such practices build familiarity, but also confidence, important factors in leading to informed use of AI, a "calibrated trust" (Ranalli, 2021, p. 14) that takes into account the affordances of a technology tool but also its limitations. Training and usage modeling have the added benefit of greater metalinguistic awareness, as learners reflect on how technology use interfaces with language learning.

For AI text generators, one of the important areas for training and learner experimentation is in writing prompts. While systems like *ChatGPT* can generate extended texts given a simple user prompt, it is more likely to provide useful texts given more detailed instructions. Those can come in the form of specific details, a particular style or level of language, or an extended outline or set of bullet points. It is also possible to provide examples to be emulated or expanded. The real power of prompt engineering, however, lies in using a series of connected prompts. Providing a set of intermediate instructions has been labeled "chain-of-thought prompting" (Wei et al., 2022) and has proven to be an effective technique. Those intermediate steps will directly involve the learner, as text output is examined, and further instructions are created. This kind of "human in the loop" approach (Cardona et al., 2023) leads AI output to represent a jointly authored effort in which the learner provides the guidance and mediation. This allows the writer to maintain control, as well as to have a finished product that shows the stamp of an individual voice and vision (see Jacob et al. 2023).

Personal experiences in using AI tools are likely to provide realistic expectations for integration of technology into L2 instruction. At the same time, language teachers will need to realize that any technology will only be effective if it aligns with the local instructional context. There are a multitude of factors which may come into play, ranging from practical issues of cost and availability to curricular considerations such as mandated methods or materials. From an ecological and complex systems perspective, technology use will result in emerging outcomes that may vary dramatically depending on the mix of tools and people integrated across different scales (individual, classroom, department, institution, national educational system). Individual teacher differences can play a major role as can student characteristics (Link et al., 2020; Renalli, 2021). The exact same tool used in different settings may lead to very different outcomes. It is also the case that individual student profiles will have an impact on the effect and effectiveness of using AI tools. It has been shown that higher proficiency learners will be able to take better advantage of the affordances than lower proficiency students who may struggle with understanding and responding to feedback (Warschauer et al., 2023).

Conclusion

No technology, not even the most advanced AI tool, can serve as a "silver bullet" (Warschauer & Ware, 2006, p. 175) for L2 learners. Teachers will need to develop a balanced approach that integrates technology use into a broader program that emphasizes authentic communication (Grimes & Warschauer, 2010). A balanced use of AI tools might involve assigning a variety of tasks, some using the tool, some not. High on the list should be tools through which students engage in active communication in the L2. Peer conversing through virtual exchange could be one approach (O'Dowd, 2021). Another could be meaningful participation in online interest groups such as fan sites (Sauro, 2017).

A worthwhile goal is to create "renewable" assignments, that is those that go beyond being academic exercise and provide real world connections. Blyth (2023) integrated AI writing tools *PickAxe* and *Sudowrite* into his advanced French course, "Narrating the multilingual self" to have students create, edit, and share multimodal texts among themselves and subsequently upload to web spaces. For teacher trainees, renewable assignments might involve contributing to knowledge stores, such as Wikipedia articles. Writing is a social practice; we write for a specific purpose and to an intended set of readers. That fact should whenever possible be foremost in assigned writing tasks, so that learners view the writing process beyond its academic role but rather as a vital life skill. Preparing students for an AI world needs to include training in appropriate uses of advanced writing assistance. As tools become a "naturalized part of the modern, globalized world" (Hellmich & Vinall, 2021, p. 4), it is irresponsible for educators to ignore their existence or dissuade learners from their use.

The integration of advanced language technologies into a variety of consumer products, including mobile and wearable devices, has led to questions as to the need for instructed language learning. That is particularly the case as AI chatbots are implemented as voice systems in smartphone apps. Dedicated devices for translation and other L2 language needs have also become available (Godwin-Jones, 2019). The question arises logically: can't we just have those smart devices support our second language needs? Perspective teachers should be aware of such assumptions, as they have been expressed in the public sphere (McWhorter, 2023). Indeed, those aspiring towards a career in language teaching might wonder if in fact there will be such employment available when they graduate. In fact, in 2023 a major research unit in the United States (West Virginia University) fired most of its world languages professors with the stated assumption that students interested in learning a second language could simply use a mobile app for that purpose.

The idea that advanced language technologies will eliminate the need for formal language instruction is not new. Crossley in 2018 suggested that the availability of machine translation in mobile devices would spell the end of language instruction, "Society may come to see learning a new language in an FL environment as an antiquated endeavor akin to using a horse for transportation" (p. 547). Already in 2013, the availability of intelligent personal assistance was seen in the popular press as eliminating the need for language teachers (Delbano, 2013). More recently, McWhorter (2023) has labeled language learning an "artisanal pursuit" (final paragraph). It is certainly the fact that AI is quite capable of handling utilitarian foreign language needs, such as translating a menu through a phone camera or using a portable interpreter to check into a hotel. A purely instrumentalist view of language, however, "fails to acknowledge the richness and complexity of human interaction, identity, and culture" (Urlaub & Dessein, 2022, p. 57). Real language use is not primarily transactional, but rather social, used to build and maintain relationships rather than to accomplish a task.

Human language use is emergentist, contingent, and messy. Furthermore, meaning making in conversations is not just based on verbal language, but is widely dependent on paralanguage, facial expressions, and gestures. Human beings can extract the nuances of meaning through hearing irony or sarcasm in tone

or reading body language expressing a message contrary to the words spoken. That capability is beyond the ability of AI to replicate. The limitations in the communicative abilities of large language models point to the essential humanness of language, namely that it is patterned, yet unpredictable, socially determined, but individually agentic. That wide variability and social contingency pose unsurmountable obstacles (currently) to AI being the equivalent of a human language user.

The availability of AI tools for language production may not eliminate the need for language teachers, but is likely to change their role, as well as to shift profoundly the nature of instructed language learning. The presence in students' lives of efficient L2 text generators and high-quality machine translation means that linguistic accuracy "can no longer be viewed as a synonym of learning and excellence" (Klekovkina & Denié-Higney, 2022, p. 107). That is likely to have a major impact on assessments, but also on the purpose and methodology of language instruction. Depending on the context, it is altogether feasible that lower-level errors (spelling, simple grammatical errors) will become less of a teaching concern as students use AI tools to proof and correct. Instead, teachers may focus more broadly on features such as organization and flow. Assigned written work should be personalized, so that students put an individual (non-AI) stamp on their work. Greater weight will be placed on achieving a personally distinct voice, as well as on originality. Spoken language practice, independent of AI devices, will continue to be needed, for developing fluency and depth. An area to emphasize will increasingly be pragmatic language, the essence of the social use of language (Hellermann &Thorne, 2022).

In an AI world a greater emphasis on the social dimension of language and language learning will be needed. While AI chatbots are likely to become learning companions, they should supplement, not substitute for human partners. The "relational pedagogy" discussed above should be understood as helping to frame human-nonhuman interactions but also to encourage the growth of *human* relationships; that is the essence of a human ecological orientation. AI services will be used for enhancing individual performance, but in an instructed environment their use should also include communal interactions. Peer discussions and comparisons of experiences will be invaluable.

Development of AI literacy is less likely to be successful as a solitary pursuit. Information exchange about AI should go beyond the mechanics of tool use, to broader social issues of power and privilege: "Beyond teaching functional digital literacies that enable learners to use tools for their own purposes, the language classroom needs to integrate a critical digital literacy that draws attention to how power operates within these digitally mediated spaces where human and nonhuman interactants are entangled" (Darvin, 2023, p. 41). Digital tools are not simply devices for accomplishing goals. Their use should be considered within local "contexts, identities, and structures" (Vinall & Hellmich, 2022, p. 14), i.e., from a broadly humanist perspective (Bender et al. 2021).

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