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Language learning using XR: Gen Z and new acquisitional paradigms[1]

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ABSTRACT

EN This article explores extended reality (XR) technologies' application in language learning, focusing on Generation Z (Gen Z) and its educational needs. This contribution argues that XR technologies offer opportunities for pedagogical exploration in relation to Gen Z's specific learning profiles. Members of Gen Z prefer interactive, technology-driven, and experiential learning environments. XR technologies—including virtual, augmented, and mixed reality—offer immersive and context-rich environments that can support situated language use, learner engagement, and motivation, as well as provide low-stakes conditions for practice that may help mitigate language anxiety. The integration of XR in education raises challenges related to cost, accessibility, digital competence, cognitive load, and ethical considerations. Consequently, the article highlights the opportunity of aligning XR-based language tasks with the specific characteristics, needs, and constraints of Gen Z learners, in the attempt to contribute to a more contextualized and critical understanding of XR's role in language pedagogy.

Keywords: LANGUAGE LEARNING, EXTENDED REALITY, GEN Z, ACQUISITIONAL FRAMEWORKS, DIGITAL NATIVES

ES Este artículo explora la aplicación de las tecnologías de realidad extendida (XR) en el aprendizaje de lenguas, con atención a la Generación Z (Gen Z) y a sus necesidades educativas. El articulo sostiene el potencial de las tecnologías XR para la experimentación didáctica en relación con los perfiles de aprendizaje de la Gen Z. Los miembros de la Gen Z muestran preferencia por entornos de aprendizaje interactivos, mediados por la tecnología y de carácter experiencial. Las tecnologías XR, que incluyen la realidad virtual, aumentada y mixta, proporcionan entornos inmersivos y ricos en contexto que pueden favorecer el uso situado de la lengua, la implicación del estudiante y la motivación, además de ofrecer condiciones de práctica de bajo riesgo que pueden contribuir a mitigar la ansiedad lingüística. La integración de la XR en la educación plantea desafíos vinculados al coste, la accesibilidad, la competencia digital, la carga cognitiva y las consideraciones éticas. El artículo subraya, por tanto, la necesidad de alinear las tareas lingüísticas basadas en XR con las características, necesidades y restricciones del estudiantado de la Gen Z, con el objetivo de contribuir a una comprensión más contextualizada y crítica del papel de la XR en la didáctica de lenguas.

Palabras clave: APRENDIZAJE DE LENGUAS, REALIDAD EXTENDIDA, GENERACIÓN Z, MARCOS ADQUISICIONALES, NATIVOS DIGITALES

IT L'articolo esplora l'uso della realtà estesa (XR) nell'apprendimento linguistico, con riferimento alla Generazione Z (Gen Z) e ai suoi bisogni educativi. Qui si evidenzia il potenziale dell'XR per la sperimentazione didattica in linea con i profili di apprendimento della Gen Z, i cui membri tendono a preferire ambienti di apprendimento interattivi, esperienziali e basati sull'uso delle tecnologie. La XR, che comprende realtà virtuale, aumentata e mista, offre ambienti immersivi e ricchi di elementi contestuali, in grado di supportare l'uso della lingua in contesti autentici e di favorire l'interesse e la motivazione; consente anche la pratica della lingua in un ambiente protetto, contribuendo a ridurre l'ansia linguistica. L'integrazione della XR nell'insegnamento solleva criticità legate a costi, accessibilità, competenze digitali, carico cognitivo e questioni etiche. L'articolo evidenzia, dunque, l'opportunità di allineare le attività linguistiche basate su XR a caratteristiche, bisogni e criticità di apprendenti della Gen Z, con l'obiettivo di contribuire a una comprensione più contestualizzata e critica del loro ruolo nella didattica linguistica.

Parole chiave: APPRENDIMENTO LINGUISTICO, REALTÀ ESTESA (XR), GENERAZIONE Z, MODELLI ACQUISIZIONALI, NATIVI DIGITALI

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1. Introduction

Extended reality (XR) technologies have come to be known as innovative tools for immersive education, particularly in the domain of language learning. The rise of Generation Z (Gen Z) has introduced to universities a cohort of learners with a strong affinity for technology, visual media, and experiential learning environments. This predisposition to interactive digital experiences, to some extent, positions them as suitable candidates for language learning via XR platforms. Consequently, this article seeks to explore the potential of XR technologies to optimize language education for Gen Z. While the benefits of XR are not exclusive to this generational cohort, the way in which this technology can enhance language learning through immersive, context-based environments that simulate real-world language use, may be particularly meaningful in relation to Gen Z, namely the predominant student population in universities at the moment.

While the potential for XR to enhance language education appears promising (Tegoan et al., 2021), and interest in incorporating XR technologies into language teaching has spread globally, research on the use of XR technologies, especially at the university level, remains sparse and is often tied to more functional approaches. Similarly, existing studies have examined XR's effectiveness independently of learner generational profiles, leaving limited discussion of how XR-based language tasks might be pedagogically shaped to address the specific characteristics of contemporary student populations.

As reported by Anesa (2025), XR technologies have been seen as a new and innovative technology, both in theory and in their application, and their spread has opened possibilities for various uses across different disciplinary fields. Indeed, XR technologies can offer unique ways to practice real-world language use, as well as providing contextual learning, and help learners connect more deeply with the languages they are studying. Furthermore, the widespread use of mobile technology and digital devices has significantly contributed to the growth of XR applications, increasing these applications' potential to revolutionize learning approaches (Hockly, 2019; Tegoan et al., 2021).

The potential of these technologies is often underappreciated, particularly in more complex forms of education and training. One of the possible reasons for this is the ambivalence toward these technologies. On the one hand, they are sometimes viewed in techno-utopian terms as revolutionary, all-encompassing solutions. On the other, they are seen as potential threats to various human abilities. This extreme dichotomy often arises from purely functional perspectives on this technology (Anesa, 2025), which can lead to unrealistic expectations and uncertainties. In particular, viewing XR as a cure-all can result in disappointment and disillusionment when this technology fails to meet expectations. Conversely, depicting XR as potentially harmful can hinder its adoption and development, thereby causing resistance to potentially beneficial advancements and preventing a balanced understanding of its practical applications, as well as leading to possible ethical concerns.

Nonetheless, early research has highlighted the positive integration of XR into educational institutions, showing a beneficial synergy for enhancing the experience of learning and teaching languages (Wibowo et al., 2016). Significant improvements in teaching quality, student motivation, and the resolution of learning challenges among students have all been observed as a result of the integration of different forms of XR into language teaching (Tegoan et al., 2021). Such benefits are reported here as pedagogical potentials, not solely generation-specific, whose realization depends on how XR is designed, implemented, and aligned with learners' needs. This is particularly relevant, as one of the key challenges of higher education is dealing with countless students entering university each year and necessitating that teaching methods and tools are continuously updated. In addition, innovation in teaching methods and tools is especially significant for language learning, which remains a critical area for developing essential 21st-century skills, and ensuring that students are well prepared for a globalized job market that requires ever-evolving skills.

In recent years, a new generation of students belonging to the Gen Z cohort has begun filling university classrooms. Accustomed to a globalized world, these young adults have had their motivation and learning habits significantly impacted by the COVID-19 pandemic, which necessitated new strategies from educators to effectively engage them. Mainly, Gen Z students appear to need constant and competent stimulation to stay motivated (e.g., Seemiller & Grace, 2018). Against this backdrop, the relevance of XR lies not in its novelty, but in its capacity to be pedagogically adapted to the affective, cognitive, and experiential conditions of learners shaped by both generational traits and post-pandemic educational experiences. In this context, integrating XR into language learning curricula may enhance performance and improve Gen Z students' educational experience by innovating teaching approaches, increasing motivation, and addressing limits of traditional methods through alignment with this cohort's learning characteristics.

2. Characterization of XR technologies

2.1. Basic features

XR technology provides immersive and interactive experiences by integrating real and virtual environments. This is done at varying degrees through simulated scenarios, interactive role-playing, and virtual interactions. More precisely, the term XR refers to a spectrum of technologies that merge real and virtual environments to create these experiences. Virtual reality (VR), augmented reality (AR), and mixed reality (MR), are located within this spectrum, offering users varying degrees of immersion and contact with digital content and environments (see O'Shiel, 2020; Skarbez et al., 2021), through the use of different devices (e.g., headsets, mobile phones, and tablets).

The spectrum of XR technologies is to be thought of as a reality–virtuality continuum (Milgram & Kishino, 1994). This continuum ranges from the physical world, in which people interact and engage with their tangible surroundings, to entirely virtual environments in which users are immersed in a completely artificial setting. Thinking in terms of the reality–virtuality continuum helps overcome dichotomic views of these technologies, because it acknowledges that XR can dynamically blend elements of physical and virtual experiences. Due to its complexity, the virtuality–reality continuum should be also understood as multidimensional in nature rather than linear. In this context, various technologies can interact and influence each other, causing their boundaries to become blurred and unstable, and making it difficult to clearly separate the different categories (O'Shiel, 2020; Steinicke & Wolf, 2020).

Within the reality–virtuality continuum, the different XR technologies are positioned as follows: VR, offering a fully immersive digital environment, is located on one end of the spectrum; at the other end, is AR, which adds digital elements to the physical world, and provides additional information or objects; MR occupies the space in-between, by combining aspects of both the real and digital worlds. Specifically, MR can involve scenarios in which digital objects interact with the real world, similar to AR, or where the setting is mainly virtual but includes some real-world components. This is known as augmented virtuality (AV) (Hawkinson, 2023).

While these technologies can have overlapping features and similarities, they are typically defined by their unique attributes (Anesa, 2025). Table 1 summarizes the key characteristics and differences between these technologies, outlining their descriptions, typical examples, devices used, and key features.

Table 1.
Comparison of Augmented Reality, Virtual Reality, and Mixed Reality Technologies.

Technology	Description	Examples	Devices Used	Key Features
Augmented Reality	Overlays virtual content onto the physical world in real time.	Marker-based AR: Scanning a photo to trigger an animation. Markerless AR: Using location data to place virtual objects.	Handheld devices (typically), head-mounted displays	Real-time interaction with physical and virtual elements. Marker-based or location-based triggering.
Virtual Reality	Immerses users in a fully synthetic environment by generally excluding the physical world.	Immersive simulations, virtual tours.	Head-mounted displays, visors	Full immersion in an artificial environment. Limited interaction with the physical world. Stereoscopic vision and motion tracking.
Mixed Reality	Combines physical and virtual environments in which interactive objects respond to user inputs (various levels of interactivity).	Interactive virtual objects in real-world settings.	Head-mounted displays, sensors, handheld devices	Various levels of integration of physical and virtual worlds. Interactive elements that respond to user actions.

The table above highlights the distinct characteristics of each XR technology by comparing their functionalities, applications, and tools. Understanding these distinctions is essential for integrating XR effectively into pedagogical approaches and maximizing its benefits for language learning and teaching.

2.2 XR for language learning

In today's globalized job market, language skills have become an indispensable asset. Proficient language skills not only facilitate seamless communication but also play a pivotal role in fostering cross-cultural understanding and collaboration, ensuring that students are equipped to navigate the ongoing process of globalization in their future careers (Chen et al., 2022).

Among the primary challenges in learning a foreign language are obtaining authentic linguistic input and the availability of practical opportunities for language use beyond the classroom (Gardner & Lambert, 1972). Consequently, students often lack motivation and cannot find relevant contexts to satisfy their learning needs nor the required professional skills (Alsamadani, 2017). XR technologies can address this challenge by providing environments that interactively simulate real-world language use. This capability has made XR a prominent tool in language teaching, leading to a consistent upward trend in the adoption of these technologies in educational contexts over the past decade (e.g., Garzón et al., 2019).

An increasing number of studies have suggested that VR applications may become valuable tools in foreign language learning (see Alwafi et al., 2022; DeWitt et al., 2022; Mustapha & Abd Karim, 2025). The main contributing factor is this technology's ability to captivate learners' interest, sustain motivation and engagement, and effectively improve communication skills. This has been particularly relevant in the post-pandemic years, as the challenges posed by COVID-19 and adherence to social distancing guidelines have further complicated practicing newly acquired language skills through in-person interactions (Alwafi et al., 2022). In this regard, XR technologies, through the creation and simulation of real-life situations, can effectively bridge the gap between language classrooms and real-world workplaces.

Positive learning outcomes associated with XR applications in language learning have been consistently reported across several literature reviews (e.g., Quintero et al., 2019; Parmaxi & Demetriou, 2020; Saltan & Arslan, 2016). For instance, Parmaxi and Demetriou (2020) have revealed that mobile-based AR is especially effective in supporting vocabulary learning and concluded that AR not only enhances learners' motivation, engagement, and enjoyment but also improves their overall performance in multiple language skills. Similarly, Solak and Cakir (2015) have illustrated the fruitful integration of AR in language learning material design, mainly in terms of increased motivation, content memorization, collaboration, and faster learning.

Looking at these technologies more closely, each can provide valuable contributions to language learning based on their specific affordances. Starting with VR, it allows learners to engage in lifelike conversations by providing fully immersive environments that simulate real-world settings. This entails practicing vocabulary in context and improving pronunciation, but most importantly, navigating cultural and pragmatic dynamics that would otherwise be inaccessible. Furthermore, as revealed by Legault et al. (2019), VR-based language instruction can significantly increase learner motivation and engagement, particularly among younger learners who value interactive experiences. Positive effects of VR have also been noted in relation to language learning anxiety (see Section 3), a common barrier for second-language learners, which appears to decrease when learners practice in low-stakes virtual environments (Martín Monje & Castrillo de Larreta-Azelain, 2022).

As for AR, its applications have been increasingly integrated into language learning thanks to their ability to provide contextualized language practice in real-world environments through the use of overlayed digital content. These applications allow learners to associate new vocabulary with real-world objects, thereby promoting retention and contextual understanding. AR can also gamify language learning, making the experience more engaging for learners who prefer dynamic, interactive environments.

Meanwhile MR, combining the functionalities of both VR and AR, allows digital and physical objects to interact in real time. This has significant potential for language learning, as it creates hybrid environments in which learners can manipulate digital objects while remaining grounded in the real world (Parmaxi & Demetriou, 2020). For instance, MR can simulate scenarios, such as ordering food in a restaurant or navigating a train station, that are complex and language-rich while, at the same time, provide real-time feedback.

However, despite the advantages of XR technologies, their application has often not taken into account the possible pedagogical needs of current students. This shortcoming arises because, as previously mentioned, XR tools are typically evaluated based on their technical capabilities rather than their integration into comprehensive educational approaches. Consequently, the novelty and technical aspects of these technologies are often prioritized over their alignment with effective teaching strategies (Saltan & Arslan, 2016).

At the same time, while these benefits have been observed across learner populations, their pedagogical relevance becomes particularly salient when considered in relation to Gen Z students, since

members of this generation are primarily aged 18–24, representing the largest cohort in universities today. The presence of Gen Z in university classrooms is becoming a defining feature of higher education, requiring teaching methods and tools to align with their characteristics and presenting both opportunities and challenges for educators. In this sense, the effectiveness of XR for language learning is not generation-specific per se, but increasingly dependent on how its affordances are aligned with the expectations, learning habits, and constraints of contemporary students.

3. Meeting Gen Z's learning needs

A generation encompasses individuals born within the same chronological, social, and historical context who often share similar characteristics and behavioral profiles (Twenge, 2017). However, systematically studying generations can be challenging, as generational traits often involve ever-changing features, and while it is possible to trace trends and behaviors, doing so aims to provide insights rather than predictions (Seemiller & Grace, 2018).

Gen Z are individuals who were born between the years 1995 to 2010 (Seemiller & Grace, 2018) or 1997 to 2012 (Barhate & Dirani, 2021; Dimock, 2019). These ranges are traced around significant historical events, such as 9/11, which is considered a key marker dividing those who remember a pre-9/11 world from those who are shaped by its aftermath without a direct memory of the event (Dimock, 2019; Seemiller & Grace, 2016, 2018).

Unlike previous generations, Gen Z students have so far been more pragmatic and future-oriented, often prioritizing career readiness and financial stability. As a result, they value practical applications of knowledge and favor learning experiences that integrate technology and foster real-world skills. However, their heavy reliance on digital technologies has led to challenges such as decreased face-to-face communication skills and increased levels of anxiety and loneliness, which are partly due to the pervasive influence of social media (Rue, 2018).

Given the limited empirical studies focused on this generation, particularly in university settings, looking at Gen Z students' key characteristics and preferences could reveal how integrating XR technology into language learning and teaching could effectively improve their learning experiences and meet their educational needs. Specifically, studies on Gen Z's learning habits have identified distinctive characteristics that make this generation particularly well suited for the application of XR in language learning.

Gen Z has been growing up in an era of information overload due to an unprecedented influx of information and data from multiple sources, including social media, online platforms, and digital devices. This, along with their exposure to digital technology earlier in their lives than previous generations, has equipped Gen Z with unique skills in digital literacy and adaptability to rapid technological advancements (Seemiller & Grace, 2018). Gen Z is also more inclined to share personal information if it results in personalized or valuable experiences, which reflects their desire for customized interactions. Furthermore, they place high value on seamless and integrated experiences, seeking engagement that fosters ongoing relationships and continuous interaction with digital platforms (Schwieger & Ladwig, 2018). Consequently, exposure to digital technology has likely made Gen Z particularly comfortable using digital tools, allowing for a suitable environment for the application of XR technologies.

This generation has also shown an inclination toward self-directed learning, leading to a preference for online education and independent study, both driven by their sense of autonomy. Additionally, Schwieger and Ladwig (2018) have highlighted recurring traits among Gen Z in this regard, such as self-sufficiency and a preference for self-education. As for the learning preferences of Gen Z, research has revealed a tendency to prefer practical and applied methods of learning to be integrated, if possible, with digital technology. This generation appears to favor applied learning the most because its members seek practical knowledge that they deem more useful for their future careers. As a result, they focus on acquiring real-world skills to develop competence. Therefore, a more hands-on learning approach may prove highly effective, specifically when it involves direct interaction with the subject matter through practical experiences. Similarly, Gen Z students express a preference for learning that is grounded in real-life experiences rather than abstract concepts. They value the opportunity to integrate the external world into their learning environment and view it as a practical laboratory for gaining understanding. This approach resonates with many in this cohort who find that hands-on learning enhances their comprehension and prepares them more effectively for real-world challenges (Seemiller & Grace, 2018). This can be supported by XR-based language tasks, through simulated, practice-oriented scenarios that allow learners to apply linguistic knowledge in context, experiment with communicative strategies, and receive immediate feedback. Indeed, XR specifically situates language use within

realistic professional or everyday settings, possibly bridging the gap between theoretical instruction and practical application.

Furthermore, the learning environment may be viewed as a dynamic field of practice in which Gen Z students can actively engage with the learning material rather than simply passively receiving information. This approach encourages active learning, critical thinking, and collaboration, making the educational experience more interactive and meaningful (Weng & Seemiller, 2024). In this respect, the characteristics of XR, such as its ability to provide immersive and multimodal experiences, are in line with Gen Z's preference for hands-on learning and developing real-life skills while enhancing engagement, motivation, and understanding. Moreover, as language practice is often affected by learning environments that often feel unnatural or artificial, XR provides more immersive and true-to-life contexts (Chen et al., 2022).

In addition to its members' preference for hands-on learning, Gen Z has shown a tendency toward intrapersonal learning, that is, a style of learning in which individuals prefer to learn independently and at their own pace. Although this does not necessarily mean that they do not appreciate the social aspects of collaborating and working with peers, they appear to significantly value personal reflection and self-directed study. Self-directed learning, whereby one can choose when, how, and where to learn, has likely been influenced by the spread of independent educational activities during one's life, such as researching information using different types of technology, using online learning platforms, or accessing various online resources (Seemiller & Grace, 2018). Regarding this, XR environments allow for individualized pacing and autonomous practicing, in which learners can revisit scenarios, repeat interactions, and adjust levels of difficulty according to their own specific needs. Not to mention, such flexibility may foster the learners' autonomy that Gen Z appears to value, including a sense of control over their progress and support self-evaluation.

This shift toward autonomous learning can be further supported by the virtual learning environments (VLEs) of XR. In fact, while some VLEs have been designed to foster learner autonomy, others focus on interactional skills and collaboration. The immersive and hybrid environments of VLEs can provide real-time feedback and dynamic interactions, leading to increased engagement and motivation (Parmaxi & Demetriou, 2020). This can be particularly true of mobile-based applications on smartphones and tablets, which are usually preferred because of their portability, interactivity, context sensitivity, connectivity, access, and individuality (Reinders & Pegrum, 2016), as well as the possibility of avoiding being tied to one location, with physical elements incorporated into their learning environments (Lindgren & Johnson-Glenberg, 2013).

Gen Z's preference for intrapersonal learning can also be linked to growing up in a world of blurred lines between real life and the online environment. As a consequence, they are particularly concerned with their digital image, which apparently affects how they participate in class. In fact, some may feel nervous about speaking in front of peers, fearing mistakes and not being perceived as intelligent. To avoid this, they may prefer staying quiet over taking risks. This fear of vulnerability can impact their self-esteem and discourage them from taking academic risks in front of others (Seemiller & Grace, 2018). This becomes especially significant in language learning, which, alongside a variety of motivational and pedagogical challenges, is particularly affected by foreign language anxiety (see Kaplan-Rakowski & Gruber, 2023). While these drawbacks are relevant, using XR can help address them by providing immersive and interactive environments that foster authentic language practice, while creating realistic, engaging, and accessible learning experiences.

The preference for visual and interactive learning modalities appears to be another characteristic of this cohort, which favors video content, interactive apps, and gamified learning experiences over traditional text-based methods (Twenge, 2017). They are also generally adept at multitasking and exhibit a shorter attention span than previous generations (Common Sense Media, 2021). As a result, learning methods that incorporate dynamic and engaging technological elements—such as those afforded by XR—may be particularly well suited to this demographic, as they align with Gen Z learners' preference for multimodal learning experiences. In line with this, Gen Z students are highly engaged in storytelling and peer experiences, often seeking information through platforms such as YouTube (Schwieger et al., 2018). XR technologies can leverage this by incorporating immersive storytelling and peer-generated content into educational programs.

Personalization is also a key factor in Gen Z's learning preferences. Unlike the one-size-fits-all approach typical of traditional education models, Gen Z thrives in environments that allow for customization and individualized learning paths. This is where XR technologies hold considerable promise as they provide personalized, adaptive learning environments in which users can interact with content at their own pace and according to their unique learning styles (Bacca-Acosta et al., 2014).

Experiential learning (i.e., the process of learning through direct experience) seems to be welcomed by Gen Z (Kolb, 2015). XR technologies can foster this by placing learners into virtual or augmented environments where they can practice skills in real-world contexts. For language learners, this could entail, for instance, stepping into virtual marketplaces to practice conversational exchanges or touring augmented foreign cities to learn cultural and linguistic nuances.

Most importantly, the learning needs of Gen Z students have been changing rapidly, influenced by having at least partially spent their school or university years during the COVID-19 pandemic, which, in turn, has further enhanced the significance of digital technology for flexible teaching and learning (Guppy et al., 2022), in line with Gen Z learners' preference for visual, problem-based, and flexible learning approaches (Frank, 2021). Current research in this regard has evidenced two opposing tendencies. On the one hand, increased levels of anxiety, depression, and vulnerability have been reported, highlighting the psychological costs of prolonged social isolation. On the other, members of Gen Z have still remained open to change and continued to demonstrate positive attitudes toward blending digital and traditional approaches, particularly in relation to communication, learning, and workplace training, reflecting a broader willingness to adapt to evolving technologies (Harari et al., 2023). This ambivalence is further confirmed by a more specific study on e-learning attitudes by Ranieri et al. (2021), which reveals that, although Gen Z learners are socially and digitally skilled, they report a lower affinity for e-learning and lower self-confidence in relation to online education.

The role of the pandemic in shaping both the learning preferences and the vulnerabilities of Gen Z students has been therefore pivotal. It has amplified their reliance on digital technologies while simultaneously exposing emotional and motivational challenges. Recognizing these initially pandemic-driven experiences, as now-structural tendencies of Gen Z's students could be essential for designing XR applications that are pedagogically grounded and responsive to this generation's characteristics and well-being.

3.1. Digital natives or tech-savvy learners?

Having grown up in an era defined by the internet, smartphones, and social media, Gen Z is often labeled as a generation of digital natives. Their interactions with technology are generally considered natural and seamless, with digital platforms playing a central role in communication, entertainment, and education (Prensky, 2001; Seemiller & Grace, 2016). It may also be argued that, unlike previous generations, Gen Z has never actually known a world without constant access to information via digital devices.

However, despite the pervasive role that digital technologies have played in the shaping of Gen Z, this generation's relationship with technology cannot be overgeneralized. Indeed, considerations of this kind must be essential when reflecting on integrating XR into Gen Z's learning environments, since familiarity with digital technologies does not automatically imply competence or confidence in educational contexts. This is particularly relevant, as the effectiveness of XR in language learning should not be assumed solely on the basis of learners' generational familiarity with technology, but rather on their ability to engage thoughtfully with technologically mediated educational environments.

The paradox consists in Gen Z learners being commonly recognized as digital natives while not necessarily demonstrating technological savviness in pedagogical or professional contexts. More specifically, while digitally innate (i.e., they are skilled with technology), and despite often lacking formal education in this area (Buhalis & Karatay, 2022), their digital proficiency and the ability to use everyday digital tools may not necessarily translate into advanced digital literacy. This calls into question their tech-savviness, meaning their ability to effectively use, understand, and adapt to digital tools and technologies. Being tech-savvy includes proficiency in navigating devices, such as smartphones, tablets, and computers, as well as leveraging online platforms for communication, education, and productivity. Therefore, while Gen Z may be highly skilled with technology, many lack the digital literacy needed to be mindful and responsible users of digital media (Hernandez-de-Menendez et al., 2020).

This tension appears to be shaped both by well-documented generational characteristics and by the formative impact of the COVID-19 pandemic. The pandemic years coincided with critical formative stages for many Gen Z individuals, during which technology became a central part of their lives. Remote learning, virtual communication, and reliance on digital platforms for everyday activities created an environment in which technology was not just a tool but a pervasive necessity. While this may have fostered digital fluency, it may also have led to overexposure and overreliance on technology. As a result, in the now post-pandemic years, this generation may be characterized by a more selective engagement with digital tools, particularly when technologies are not perceived as meaningful or purpose-driven. This may have had lasting implications for

Gen Z's interaction with digital technologies, which, while requiring further research, may still be worth considering.

Overall, previous generations have generally recognized the importance of technology in enhancing learning experiences, but Gen Z may view it as less transformative, often taking it for granted (Hernandez-de Menendez et al., 2020). Arguably, this tendency may make them less inclined to put effort into learning and appreciating new technologies. For this reason, the effectiveness of XR-based learning may depend less on the novelty of the technology itself and more on how meaningfully it is integrated into pedagogical practice.

3.2. Pedagogical perspectives

The pedagogical effectiveness of XR in language learning can be understood through the lens of numerous approaches which can effectively support the adoption of these technologies for language learning and for teaching the current generation of university students. Starting with constructivist learning theories, i.e., positing that knowledge is actively constructed through experience and social interaction (Vygotsky, 1978), they can be supported by XR use of immersive environments in which learners can engage in authentic, meaningful interactions that mirror real-life language use. The principles of situated learning are supported by XR usage as well. According to this perspective, learning in context is fundamental and encouraged (Lave & Wenger, 1991), and in XR environments, learners are generally considered active participants who must use language to navigate and interact within their virtual or augmented worlds.

Another theoretical framework relevant to XR-based language learning is embodied cognition, which suggests that cognition is deeply rooted in the body's interactions with the environment (Lakoff & Johnson, 1999). XR allows for embodied learning by integrating physical actions (e.g., moving, pointing, and interacting with objects) with linguistic tasks, thereby creating a multisensory learning experience. Adams et al. (2021) showed that XR-enhanced language learning can lead to greater retention and comprehension, particularly in areas such as spatial vocabulary and prepositional phrases, where learners can physically engage with the language.

XR is also well suited to support communicative language teaching (CLT), which emphasizes interaction and communication as the primary goals of language learning (Richards, 2006). In this sense, XR provides opportunities for learners to engage in authentic dialogs with virtual avatars or other learners in a variety of social contexts, from informal conversations in virtual cafés to formal presentations in simulated business meetings or conferences. Thus, learners are exposed to the cultural and pragmatic aspects of language use, which are difficult to replicate in traditional learning settings (Lin & Lan, 2015).

Motivation and engagement are additional aspects to consider. For Gen Z learners who are accustomed to fast-paced, visually rich digital environments, XR's immersive experiences are specifically expected to be well received. Motivation is a critical factor in language acquisition, and research suggests that learners who are more engaged in the learning process are more likely to persist in their studies and achieve higher levels of proficiency (Dörnyei, 2009). This may be further supported by XR's gamified elements, personalized feedback, and interactive environments, which can help sustain learner motivation by making language practice enjoyable and rewarding.

Together these theoretical perspectives indicate that the use of XR in language learning can be pedagogically grounded. At the same time, the very features that make XR effective from a pedagogical standpoint closely align with the learning preferences and characteristics of Gen Z outlined above, suggesting that XR-based approaches may be particularly well suited for this cohort of learners.

3.2.1. Addressing language anxiety

As previously mentioned, Gen Z has shown to exhibit higher levels of anxiety compared to previous generations. The constant presence of social media in the lives of this generation has significantly contributed to heightened anxiety, particularly regarding how its members are perceived by others. Platforms such as Instagram, Snapchat, and TikTok are designed to encourage constant self-presentation and comparison, while perpetual connectivity fosters an environment in which social validation is sought through likes, comments, and follower counts. Moreover, the curated nature of social media amplifies this pressure, as users often compare their own lives to the idealized, filtered versions of others they view on social media. Additionally, the fear of missing out (FOMO), driven by social media's constant updates and portrayals of others' experiences, exacerbates these feelings of exclusion, anxiety, and low self-esteem (Seemiller & Grace, 2018).

Arguably, the heightened level of anxiety in this generation may further aggravate language anxiety as well. Language anxiety is characterized as a unique combination of self-perceptions, beliefs, emotions, and

behaviors specifically associated with classroom language learning. It refers to feelings of stress, nervousness, and worry as well as emotional reactions tied to the challenges of acquiring a second or foreign language (Horwitz et al., 1986; MacIntyre, 1999). This phenomenon is considered a significant challenge for language learners, as it negatively affects the process of learning a foreign language (Horwitz, 2001). This aspect may, therefore, be particularly relevant for Gen Z learners, for whom fear of social exposure, evaluation, and digital self-presentation may intensify language anxiety, making low-stakes, avatar-mediated XR environments especially pedagogically valuable.

Research by Nurkhamidah (2020) has revealed that although Gen Z students can access language materials through various online platforms, such as games, films, and videos, they still experience significant anxiety in listening activities. Meanwhile, their high levels of FOMO may affect their focus and confidence during academic tasks. Therefore, it may appear that language anxiety is prevalent among Gen Z students. A way to effectively address this challenge could involve leveraging XR technology to create more supportive and engaging learning environments for this cohort.

Although practicing speaking skills is a crucial aspect of language learning, many learners experience anxiety when speaking in a foreign language, particularly in public. XR can help reduce language anxiety by providing a low-stakes environment in which users can practice language without fear of being judged or making mistakes in front of their peers. It is often stated that VR, in particular, allows learners to engage in conversations with virtual characters, giving them the confidence to practice and refine their language skills before transitioning to real-world interactions.

That being said, these benefits in terms of language anxiety should not draw attention away from the potential discomfort and stress that immersive technologies may also induce. A specific body of research has documented these technologies' risk of cybersickness (e.g., Al Khalifah et al., 2025; Guo et al., 2025; Hasibuan et al., 2025). Initially used to describe side effects from use of virtual environments (McCauley & Sharkey, 1992), it indicates form of motion-related discomfort experienced during or after exposure to these environments. Among the technologies encompassed by XR, VR has been found to be particularly associated with higher levels of cybersickness, with common symptoms including dizziness, nausea, disorientation, visual fatigue, headaches, and, in some cases, heightened anxiety (Rebenitsch & Owen, 2016; Simón-Vicente et al., 2024). These effects are primarily attributed to sensory conflicts, namely, mismatches between visual motion cues and vestibular or proprioceptive feedback, as well as individual differences in user susceptibility (Saredakis et al., 2020).

Adding to this, the introduction of a new technological tool in a learning environment may itself be a source of discomfort, which can be further aggravated by initial unfamiliarity with head-mounted displays or interactive virtual environments. This may be particularly true for beginner users or individuals displaying less tech-savvy or even technophobic attitudes. In these cases, the risk of increasing both cognitive and affective load may be even greater. A further contributing factor concerns the duration of exposure, as discomfort has been shown to be more likely during longer sessions or when users are exposed to artificial locomotion (Rebenitsch & Owen, 2016; Weech et al., 2019).

3.2.2. Challenges and limitations

Challenges regarding XR typically concern its use in educational contexts more broadly, but with the adoption of XR in language education, these acquire particular relevance when considered in relation to the characteristics of the current student population. Indeed, these challenges are not merely technical or institutional but are closely connected to the above-mentioned characteristics of the learner population (e.g., uneven digital literacy, heightened sensitivity to anxiety, and post-pandemic technology fatigue) and directly shape how XR-based language tasks may be perceived.

One of the primary barriers to the widespread adoption of XR in language education is accessibility. High-quality XR hardware, such as VR headsets and MR devices, remains expensive and out of reach for many educational institutions and learners. In addition, cost constraints may directly affect the feasibility of implementing immersive speaking, pronunciation, or interaction tasks, as these frequently need dedicated hardware as well as software infrastructure (e.g., text-to-speech services, licenses, cloud services, recording storage). Mobile-based and browser-based XR applications provide a more affordable alternative in this regard. These can effectively support language-specific activities including pronunciation training and contextualized vocabulary practice without requiring expensive equipment (Martín-Monje & Castrillo de Larreta-Azelain, 2022).

As mentioned earlier, another challenge in this regard is the level of digital literacy required to effectively use XR technologies for both learners and teachers. While Gen Z is generally considered digitally innate, learners do not all possess the same level of proficiency with XR hardware and software. Not to mention, learners' ability to navigate virtual environments may significantly influence learning outcomes such as vocabulary acquisition, self-efficacy, and sustained participation (Chen et al., 2022). Educators, on their part, need training to successfully integrate XR technologies into their teaching practices while providing training and support to ensure that learners can navigate XR tools effectively and focus on learning gains rather than overcoming technical difficulties.

Another challenging aspect concerns the cognitive load brought on by XR technology. Some scholars state that technologies of this kind allow for a decrease in cognitive overload, while others note that because XR environments are highly immersive and multisensory, they can lead to cognitive overload if not properly managed. Cognitive overload occurs when the demands of a learning task exceed the learner's processing capacity, leading to reduced comprehension and retention (Sweller, 2010). To avoid this, language learning tasks in XR environments must be carefully designed to balance immersion with clarity and focus, ensuring that learners are not overwhelmed by the complexity of the virtual environment. Nonetheless, cognitive load is a critical factor to consider in the application of XR technologies for language learning, as it directly impacts the effectiveness of instructional design. According to Cognitive Load Theory, learning involves the interaction of working memory and long-term memory, with cognitive processes linked to working memory playing a central role (Chandler & Sweller, 1991; Moreno, 2004; Sweller et al., 2011). Excessive cognitive load can hinder information processing, perception, and learning (Beddow, 2018; Chandler & Sweller, 1991). Therefore, to minimize unnecessary cognitive load and support effective learning, instructional design must be implemented (Sweller et al., 2011). This means, for instance, that language learning materials should be designed to avoid overloading working memory (Sweller, 2014). Indeed, properly designed XR applications can manage cognitive load by breaking down complex information into smaller, digestible segments, enabling learners to process content more effectively (Buchner et al., 2022; Elford et al., 2022). However, poorly designed XR tools risk increasing extraneous cognitive load, which can overwhelm learners and hinder their ability to focus on essential learning tasks.

As with any emerging technology, XR also presents psychological and ethical concerns that must be addressed. Currently, the psychological effects of prolonged immersion in virtual environments are not yet fully understood, but the potential ethical concerns have already started to emerge. For example, the use of AI-powered avatars raises concerns, as their synthetic voices may encode a "default" accent or register as implicitly "professional," risking the reinforcement of linguistic or accent bias. Data privacy issues may also be considered, as XR environments frequently involve the recording and processing of learners' voices, error patterns, and overall performance data. The cloud-based storage or processing of such data, therefore, raises issues of consent, transparency, data retention, and trust (e.g., Miao et al., 2021; Porayska-Pomsta et al., 2023). These concerns have direct implications for the design and implementation of XR-based language learning applications. In particular, they may require the disclosure of synthetic or recorded speech, the provision of opt-out alternatives, the minimization of stored voice data, the avoidance of native-speaker norm defaults, and the inclusion of diverse accents and communicative roles.

4. Conclusion

This article has attempted to bridge the pedagogical benefits of XR for language education with the learning needs of Gen Z, given that its members represent most of the current university student population. The main assumption behind this has been that the specific affordances of XR are well aligned with Gen Z's learning preferences and could effectively harness the characteristics of this generation.

Current research has documented positive outcomes associated with the integration of XR in educational settings, including improvements in student motivation and teaching effectiveness (Tegoan et al., 2021). In language learning contexts, these outcomes are linked to XR's capacity to provide immersive, contextualized, and interactive environments that support authentic language use and help address challenges such as limited exposure to real-world communication and language anxiety. While XR remains pedagogically beneficial for language learning more broadly, its immersive and flexible environments appear particularly suitable for Gen Z learners, who tend to prefer hands-on, experiential, visual, and self-directed forms of learning. Specifically, XR can support meaningful language use and personalized engagement by aligning with Gen Z's familiarity with digital environments and inclination toward practice-oriented learning. In this way, integrating XR into language curricula may enhance learner motivation while aligning with students' learning

habits and technological comfort, making language learning more dynamic, effective, and relevant to their future careers. Consequently, the design and implementation of XR-based language tasks could be positively affected by considering the peculiarities of this generation, maintaining pedagogical value in a careful and context-sensitive integration of XR in contemporary university settings.

Nonetheless the arguments reported here do not claim a generation-exclusive effect. Rather, it is suggested that the pedagogical affordances of XR are particularly well aligned with the characteristics and learning conditions of Gen Z. From this perspective, pairing XR with Gen Z is not a claim of exclusivity, but an attempt to examine how existing XR affordances may be pedagogically and more meaningfully leveraged for this specific cohort. Moreover, this potential alignment is not intended to serve as a cure-all, as important tensions related to tech-savviness, language anxiety, and post-pandemic educational experiences still remain. Additionally, recognizing issues related to accessibility, cost, cognitive load, learner well-being, and ethics is essential for the effective adoption of emerging technologies such as XR in educational contexts.

Furthermore, while generational research provides valuable insights into common traits within cohorts that can be matched to potential applications of XR, the limitations inherent in both generational research and technological determinism should not be overlooked. Generational research often faces challenges related to overgeneralization since the characteristics and behaviors observed in Gen Z may not uniformly represent the entire cohort due to its diversity. Additionally, the temporal and contextual factors of this study's findings may evolve rapidly with the ongoing technological and socioeconomic changes. Regarding technological determinism, an overemphasis on technology can obscure the impact of the social, cultural, and pedagogical factors that interact with it. The assumption that XR technologies have a uniform impact across all learners and settings may overlook the varied outcomes resulting from different implementations and user experiences. Initial excitement surrounding new technologies can lead to inflated expectations and potential disillusionment if the actual effectiveness does not meet the projected outcomes.

Regarding future applications of XR in language learning, a key potential lies in its integration with artificial intelligence (AI) and machine learning technologies. Indeed, AI can provide real-time feedback on pronunciation, grammar, and vocabulary usage, allowing for more personalized and adaptive learning experiences (e.g., Hirzle et al., 2023). Similarly, machine learning algorithms can analyze learner data to identify patterns and predict areas where learners may struggle, offering targeted interventions to support language acquisition.

In addition, while much of the current research on XR focuses on individual learning, the potential for collaborative and social learning in XR environments is vast and often underinvestigated. In this respect, future research should explore how these social XR environments can be leveraged to promote communicative competence and intercultural understanding in language learners.

Cross-disciplinary applications also represent key opportunities for the development of new paradigms for the use of XR in language learning since the interdisciplinary nature of XR allows for cross-curricular integration. For example, learners can practice language skills while exploring virtual environments related to history, science, or art, thereby enriching their language learning experience with knowledge from other fields. This cross-disciplinary approach aligns with Gen Z's preference for learning experiences that are relevant to real-world applications and problem-solving.

Finally, research on Gen Z is still in its early stages, and it will continue to be challenged by the fact that it deals with an ongoing phenomenon. Meanwhile, the study of the applications of XR for language teaching at the university level is still underway. Therefore, the trends and behaviors identified should be viewed as general tendencies rather than as definitive patterns applicable to every individual within this generation (Seemiller & Grace, 2018). While adopting a generational perspective can provide insights into the potential applications of XR in language learning, it is not designed to predict specific trends or behaviors. Instead, it serves as a lens for better understanding the ongoing development and potential of XR technologies in language teaching, with the aim of informing future research in this field.

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