Instructional design guide for Augmented Reality in language learning

Authors: Antigoni Parmaxi, Anke Berns, Lina Adinolfi, Alice Gruber, Mikhail Fominykh, Angeliki Voreopoulou, Fridolin Wild, Paraskevi Vassiliou, Eirini Christou, Concepción Valero - Franco, Tormod Aagaard, Stella Hadjistassou, Pedro Jesús Molina Muñoz, and Ismael Cross-Moreno

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Editors: Antigoni Parmaxi, Lina Adinolfi, Mikhail Fominykh, Paraskevi Vassiliou, and Eirini Christou

Contributors: Antigoni Parmaxi, Anke Berns, Lina Adinolfi, Alice Gruber, Mikhail Fominykh, Angeliki Voreopoulou, Fridolin Wild, Paraskevi Vassiliou, Eirini Christou, Concepción Valero-Franco, Tormod Aagaard, Stella Hadjistassou, Pedro Jesús Molina Muñoz, and Ismael Cross-Moreno

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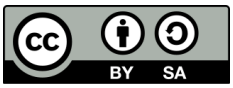

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Executive summary

This guide is an instructional design resource for Augmented Reality (AR) in language teaching and learning. It is specifically created for language teachers, designers, digital experts, and anyone interested in incorporating AR into language learning. The guide aims to provide practitioners and researchers with knowledge to create effective, engaging, and contextual learning experiences using AR. The guide brings together cutting-edge AR technology with pedagogical theory to address the limited application of AR in instructed language learning. It covers various AR implementations, whether in-person or online, for beginner or advanced levels, and in school or university environments. The guide is organised into four main parts:

Section 1: Introduces key terminology, including a definition of AR and its place within the virtuality continuum (Physical Reality, AR, Mixed Reality, Virtual Reality). It also covers the evolution and different types of AR (marker-based, markerless, location-based).

Section 2: Outlines the benefits of AR in language learning, such as enhanced motivation, engagement, reduced anxiety, increased confidence, and improved cultural awareness. It also details the challenges, including technical issues, cognitive load, lack of AR skills, and limited scope. This section further explores specific linguistic elements (vocabulary, pronunciation, morphology, grammar, phraseology, pragmatics) and communicative modes (listening, speaking, reading, writing) that can be practised and enhanced with AR.

Section 3: Focuses on setting the scene for teaching with AR, discussing how AR aligns with general learning design principles and pedagogical theories like constructivism, sociocultural, and situated learning. It provides considerations for learning experience design, emphasising collaboration, task-based activities, and tailoring to target groups.

Section 4: Presents real-life scenarios and practical task design examples for implementing AR in language learning. The guide concludes with a checklist to practically support language instructors in designing AR-enhanced language lessons. It advises on clarifying teaching goals, identifying pedagogical approaches, designing activities, selecting AR tools, checking device availability and internet connectivity, designing and testing AR activities, facilitating student and peer interaction, and reinforcing learning.

Innovation and impact: This guide is an innovative and unique resource that provides a set of guidelines and best practices for AR in language learning, tailored to the specific needs of language instructors and instructional designers. It is expected to support language learning through structured knowledge on this rapidly developing technology. This guide has relevant research publications presented in local and international conferences and international research journals.[1]

[1] Parmaxi, A., Berns, A., Adinolfi, L., Gruber, A., Fominykh, M., Voreopoulou, A., Wild, F., Vassiliou, P., Christou, E., Valero-Franco, C., Aagaard, T., & Hadjistassou, S. (2024). Augmented reality in language learning: Practical implications for researchers and practitioners. In P. Zaphiris & A. Ioannou (Eds.), *Learning and collaboration technologies: 11th International Conference, LCT 2024, held as part of the 26th HCI International Conference, HCII 2024, Washington, DC, USA, June 29–July 4, 2024, proceedings, Part III* (pp. 138–154). Springer. https://doi.org/10.1007/978-3-031-61691-4_11.
Christou, E., Vassiliou, P., & Parmaxi, A. (2025). Augmented reality in language learning: a systematic literature review of the state-of-the-art and task design considerations. *Innovation in Language Learning and Teaching*, 1-28.
Berns, A., Zarraonandia, T., Onorati, T., Díaz, P., & Dodero, J.-M. (2025). The Use of VR/AR End-User Development Tools in Education: Lessons Learned and Future Challenges. *Education in The Knowledge Society*, *26*, e31855. https://doi.org/10.14201/eks.31855

How to use this guide

This guide is aimed at anyone who is interested in designing and implementing AR activities in language classrooms - be these in-person or online, beginner or advanced level, or school or university environments. By the end of the guide, readers should have a better understanding of what AR is, be aware of the benefits and challenges of its application to language learning, discover ways of designing and implementing AR activities, and explore real examples of AR use in language learning. The content of the guide is visualised as a sequential roadmap in Figure 1.

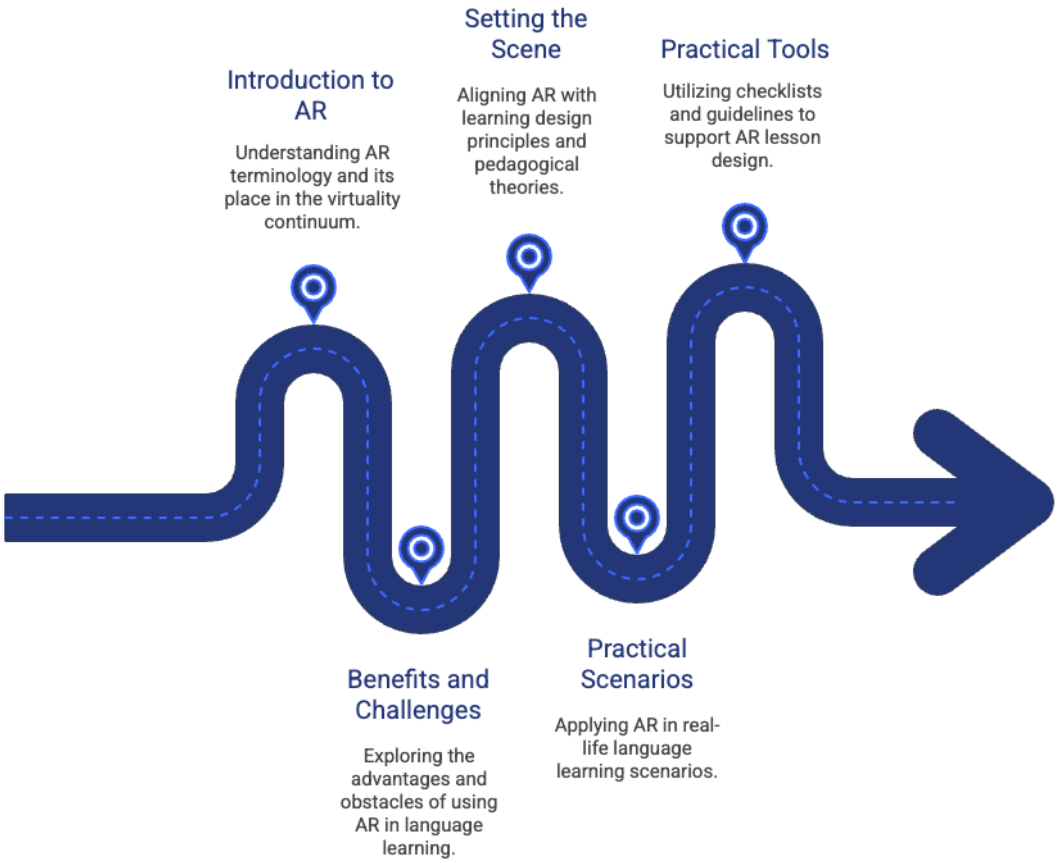

Figure 1. *Roadmap of the table of contents of the instructional design resource for AR in language learning and teaching. It illustrates five sections: introduction to AR, benefits and challenges, setting the scene, practical tools, and practical scenarios (own figure created with Napkin).*

Gruber, A., Berns, A., & Fominykh, M. (2024). Enhancing language teaching with augmented reality: Insights from the ARIDLL project. In CALL for Humanity - EUROCALL 2024 Short Papers (pp. 155-162). https://doi.org/10.4995/EuroCALL2024.2024.19056

Section 1: Introduction and terminology

1.1 Introduction

Traditionally, language teaching resources and tools, such as textbooks or videos, often fail to fully engage students or provide sufficient real-world practice, which can lead to disengagement and slower progress.[2] Augmented Reality (AR) addresses these limitations, by offering an engaging and practical way to learn, allowing digital content to be overlaid directly onto the physical world. AR is defined as a technology that superimposes digital information, such as texts, images, videos, 3D models, and sounds, onto real-world environments, creating an immersive and interactive learning experience.[3] The integration of virtual and real content facilitates interaction and allows for real-time engagement in three dimensions.[4,5,6,7] For language instructors, instructional designers, and researchers this presents an opportunity to go beyond conventional materials and give learners the chance to engage with language in three dimensions and in real time.

Since its initial integration into language teaching in the early 2010s, often involving location-based games and QR code scanning for mobile quests, AR's use has steadily increased.[8] The convenience and low cost of mobile AR applications have made them accessible on various devices, allowing students to use their own smartphones and tablets for learning anytime, anywhere. For instance, "Mentira" was an early example, a place-based mobile game designed for L2 Spanish learners where they followed AR-triggered clues in their environment to solve a mystery.[9] Another example is "ChronoOps," a quest-driven mobile AR game used by university students for language learning tasks involving spatial navigation and collaborative problem-solving in specific real-world locations. These early studies often focused on collaborative, gamified scenarios outside the classroom and the development of AR-enhanced virtual tours. Since the latter half of the 2010s, low-immersion AR, typically using handheld devices like smartphones and tablets, has become increasingly prevalent in language learning contexts. Beyond location-based games, AR has evolved to trigger the display of contextual information, such as online videos, word-image associations and virtual humans directly on a user's device.[10]

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[2] Azimova, D., & Solidjonov, D. (2023). Learning English language as a second language with augmented reality. *Qo‘qon Universiteti Xabarnomasi, 1*(1), 112–115. https://doi.org/10.54613/ku.v6i6.264

[3] Azimova, D., & Solidjonov, D. (2023). Learning English language as a second language with augmented reality. *Qo‘qon Universiteti Xabarnomasi, 1*(1), 112–115. https://doi.org/10.54613/ku.v6i6.264

[4] Demirdag, M. C., Kucuk, S., & Tasgin, A. (2024). An investigation of the effectiveness of augmented reality technology supported English language learning activities on preschool children. *International Journal of Human–Computer Interaction, 41*(2), 1–14. https://doi.org/10.1080/10447318.2024.2323278

[5] Bonner, E., & Reinders, H. (2018). Augmented Reality and Virtual Reality in the language classroom: Practical ideas. *Teaching English with Technology*, *18*(3), 33–53. http://www.tewtjournal.org

[6] Lytridis, C., Tsinakos, A., & Kazanidis, I. (2018). ARTutor—An augmented reality platform for interactive distance learning. *Education Sciences*, *8*(1), 6. https://doi.org/10.3390/educsci8010006

[7] Terzopoulos, G., & Tsinakos, A. (2020). IPEAR. O1.1 A review of Augmented Reality Tools for Building Educational Experiences (unpublished).

[8] Kaplan-Rakowski, Regina and Papin, Kevin, Augmented Reality-Assisted Language Learning (ARALL) (May 01, 2024). Available at SSRN: https://ssrn.com/abstract=4894258 or https://doi.org/10.2139/ssrn.4894258

[9] Kaplan-Rakowski, Regina and Papin, Kevin, Augmented Reality-Assisted Language Learning (ARALL) (May 01, 2024). Available at SSRN: https://ssrn.com/abstract=4894258 or https://doi.org/10.2139/ssrn.4894258

[10] Kaplan-Rakowski, Regina and Papin, Kevin, Augmented Reality-Assisted Language Learning (ARALL) (May 01, 2024). Available at SSRN: https://ssrn.com/abstract=4894258 or https://doi.org/10.2139/ssrn.4894258

The goal of this guide is to demonstrate how AR can transform the language learning experience. By creating engaging, dynamic, and practical resources, educators can move language teaching out of the textbook and into the learner's daily life. This allows for a deeper and more meaningful connection to the target language.

1.2 First things first: the virtuality continuum

In the early 90s, Milgram et al. (1995, 283)[11] observed that "although the term 'Augmented Reality' has begun to appear in the literature with increasing frequency, we contend that this is occurring without what could reasonably be considered a consistent definition". Thus, a Reality-Virtuality Continuum was devised —first described in Milgram and Kishino (1994)[12] — as a means of demonstrating how these terms connect with one another. At one extreme of the continuum is a fully real environment (the real world), and at the other is a fully virtual environment, i.e. Virtual Reality (VR). Everything in between may be described as Mixed Reality (Figure 2). However, Milgram and Kishino's (1994) original concept of Mixed Reality (MR) has nevertheless since been extended and is now known as Extended Reality (XR).[13]

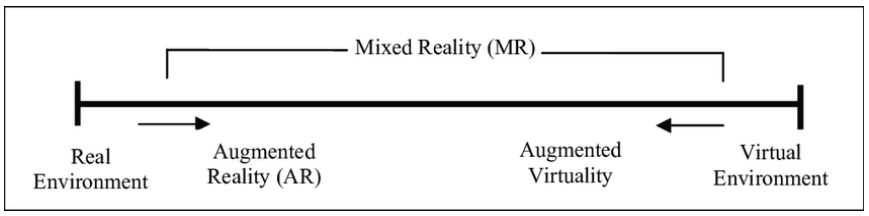


Figure 2. *Representation of the Virtuality Continuum (adapted from Milgram & Kishino 1994[6]).*

The Reality-Virtuality Continuum provides a spectrum or continuum that categorises different levels of immersion and presence experienced by users in VR and AR systems. The continuum ranges from the real environment at one end to fully virtual environments at the other end, with MR environments situated in between. The Reality-Virtuality Continuum consists of four main categories:

1. **Physical Reality:** This category represents the real world and refers to the physical environment that we naturally perceive with our senses. It includes everything we experience in our everyday lives without any technological mediation. In this state, there is no augmentation or virtualisation.
2. **Augmented Reality (AR):** AR is situated between physical reality and virtual reality on the continuum. In AR, virtual elements are superimposed onto the real environment, enriching the user's perception and interaction with the physical world. This can be achieved using various technologies such as headsets, glasses, or mobile devices that overlay computer-generated content onto the real-world view.

[11] Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1995, December). Augmented reality: A class of displays on the reality-virtuality continuum. In *Proceedings of SPIE: Telemanipulator and Telepresence Technologies* (Vol. 2351, pp. 282–292). SPIE. https://doi.org/10.1117/12.197321

[12] Milgram, P., Takemura, H., Utsumi, A., & Kishino, F. (1994). Augmented reality: A class of displays on the reality-virtuality continuum. *Proceedings of SPIE - The International Society for Optical Engineering, 2351*, 282–292. https://doi.org/10.1117/12.197321

[13] Aguayo, C., & Eames, C. (2023). Using mixed reality (XR) immersive learning to enhance environmental education. *The Journal of Environmental Education, 54*(1), 58–71. https://doi.org/10.1080/00958964.2022.2152410

3. **Mixed Reality (MR):** MR represents an intermediate point on the continuum, blending elements of both physical reality and virtual reality. In MR, virtual objects and the real world coexist and interact in real-time. Users can perceive and interact with virtual content that is anchored to and aligned with the physical environment. MR often involves wearable devices like headsets that can track the user's position and dynamically adjust the virtual content accordingly.
4. **Virtual Reality (VR):** VR is positioned at the extreme end of the continuum, offering a fully immersive digital experience. In VR, users are completely transported into a simulated environment that may be entirely computer-generated or a realistic representation of the physical world. By wearing headsets or using other immersive devices, users can perceive and interact with the virtual environment as if they were physically present within it.

The Reality-Virtuality Continuum provides a useful framework for understanding the different levels of immersion and interaction in VR and AR systems. It illustrates the progression from the real world to increasingly mediated and virtual experiences, allowing researchers and developers to analyse and compare the impact and potential of different technologies and applications in this field.

1.3 What do we understand by AR?

As noted earlier, AR is often defined as an altered form of reality in which computer-generated content is superimposed on the user's real-world view. By doing so, AR provides users with a highly visual and dynamic environment, with which they can interact in real-time. However, what makes AR unique and different from other technologies, such as VR or MR, is that it encompasses several features simultaneously such as the superimposition of virtual content and real-time interaction (Figure 3)[14].

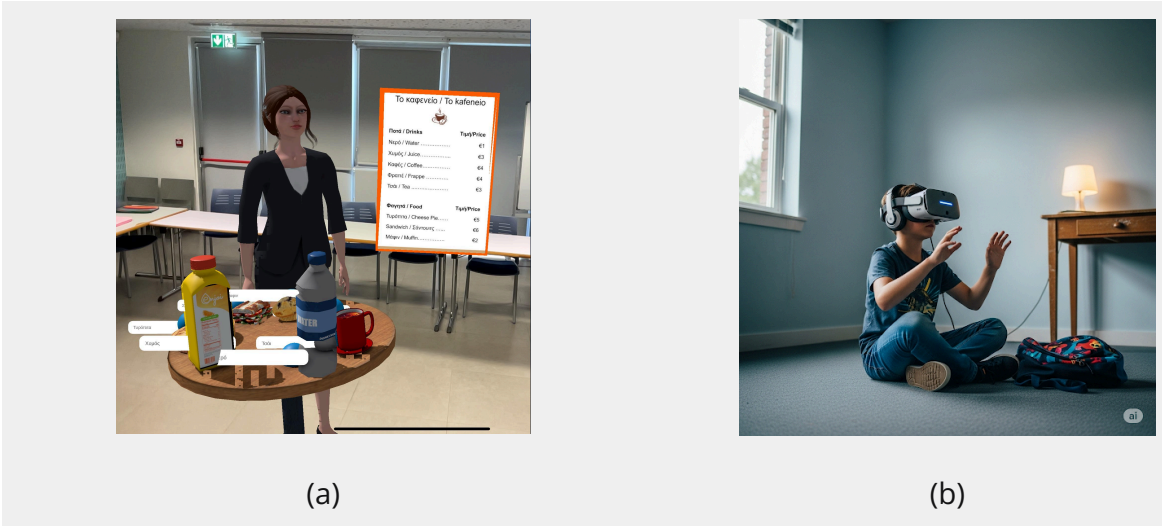


Figure 3. *Comparing AR with VR: (a) AR combines a digital layer and the real world (own figure); (b) High Immersion VR creates a fully immersive simulated environment that replaces the real world entirely (created with Gemini).*

[14] You can find more information regarding immersive environments in language learning here: https://www.youtube.com/watch?v=-dzIYB26FqA&t=2s

1.4 The beginning and evolution of AR technology

The beginning of AR in language learning in the early 2010s, primarily involved location-based AR, often leveraging mobile devices to scan QR codes or signs as integral parts of mobile-based quests that incorporated gamification elements. Common activities included scanning flashcards and QR codes to reveal 3D AR objects, animations, or multimedia content such as texts, videos, and audio in the target language, aiming to enhance cultural understanding and language skills like vocabulary and grammar. Other early applications required learners to interact with real people and places in game-based environments to practice new words and phrases in context.[15]

The early 2010s were also marked by the rise of significant AR technologies, with a focus on both software and hardware innovation. In 2011, for example, the Vuforia AR software development platform was launched, which allowed developers to create sophisticated AR applications for a variety of devices. Concurrently, groundbreaking hardware like Google Glass, a wearable smart-glasses device with an integrated display and camera, was introduced, pushing the boundaries of what was possible with AR. However, it is important to note that neither Vuforia nor Google Glass were designed specifically for educational purposes. In the forthcoming years, Vuforia has been used in various fields, including education aiming to enhance learning experiences by overlaying digital content onto physical objects or printed materials. For example, educators have used Vuforia to create AR simulations or models that allow students to explore and interact with virtual objects in a more engaging and immersive way.

Since the latter half of the 2010s, low-immersion AR has become increasingly prevalent, largely due to the widespread availability and accessibility of handheld devices like smartphones and tablets.[16] These devices, equipped with built-in cameras, GPS sensors, and internet access, have made AR technology easy to use and no longer dependent on expensive, sophisticated equipment.

AR platforms, which are software development frameworks specifically designed for creating AR experiences, enable users to design their own triggers and overlays to enhance the real-world environment. Triggers are elements that either initiate or activate AR content when detected by the system. They can take various forms, such as markers, images, objects, or specific patterns, which serve as recognisable cues for the AR application.[17] When the system identifies a trigger, it prompts the display of augmented content associated with that trigger. Markers, a type of trigger, are specific visual patterns or symbols designed to be recognised by the AR system. They act as reference points or targets for the AR application to track and overlay digital content onto the real-world scene. The markers are typically printed images or patterns that the system can detect and use as a basis for precisely aligning the virtual content with the physical environment. Overlays, on the other hand, refer to the digital content that is superimposed or overlaid onto the real-world view through AR. These overlays can include various elements such as 3D models, animations, videos, text, or interactive elements. Overlays enrich the user's perception of the environment by providing additional information, context, or interactive experiences, seamlessly blending virtual content with the real world. In summary, triggers,

[15] Kaplan-Rakowski, Regina and Papin, Kevin, Augmented Reality-Assisted Language Learning (ARALL) (May 01, 2024). Available at SSRN: https://ssrn.com/abstract=4894258 or https://doi.org/10.2139/ssrn.4894258
[16] Kaplan-Rakowski, Regina and Papin, Kevin, Augmented Reality-Assisted Language Learning (ARALL) (May 01, 2024). Available at SSRN: https://ssrn.com/abstract=4894258 or https://doi.org/10.2139/ssrn.4894258
[17] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c

including markers, serve as recognisable cues that activate AR content, while overlays refer to the digital content overlaid onto the real-world view. Markers, in particular, are a specific type of trigger that relies on visual patterns or symbols, acting as reference points or targets for precise alignment of virtual content.

Contemporary smartphones support AR use in many ways as they have various mechanisms such as sensors that can be operated by touch, gesture, voice, and location-awareness.[18,19,20] Amongst the most popular sensors are Optical Character Recognition (OCR), a technology that enables smartphones to recognise and extract text from images or documents, Global Positioning System (GPS), a satellite-based navigation system that provides location and time information, allowing smartphones to determine their precise geographical coordinates, Quick Response (QR) codes, that is two-dimensional barcodes that can store and make available information, through the use of website URLs. Smartphones can scan QR codes using their cameras to access the encoded information. Radio Frequency Identification (RFID) is a technology that uses radio waves to wirelessly identify and track objects equipped with RFID tags. Smartphones can interact with RFID-enabled objects or tags to retrieve information or trigger actions. Finally, Near Field Communication (NFC) enables short-range wireless communication between smartphones and other compatible devices or tags. NFC is often confused with Bluetooth, however these are two distinct wireless communication technologies. NFC is commonly used for contactless payments, data exchange, and the easy pairing of devices.

1.5 Types of AR

In AR, virtual content can be presented in either two-dimensional (2D) or three-dimensional (3D) forms, depending on the desired experience. AR applications can be categorised based on their purpose, place of use, and usability into three groups: marker-based AR, marker-less AR, and location-based AR.[21,22,23] These may be distinguished as follows:

a. Marker-based AR applications that rely on specific visual markers, like QR codes, to anchor virtual content in the real world.
b. Markerless AR applications that do not require predefined markers and instead use computer vision or object recognition technologies to detect and interact with real-world objects or surfaces.
c. Location-based AR applications that utilise the geographical position of the user and leverage GPS or other location-based technologies to provide context-aware virtual content or experiences tied to specific locations or areas.

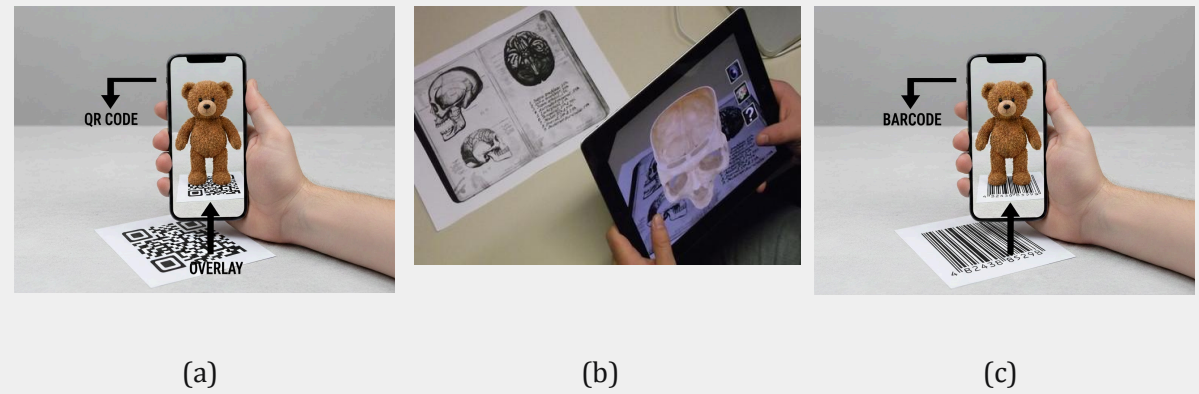
[18] Chiang, T. H., Yang, S. J., & Hwang, G. J. (2014). An augmented reality-based mobile learning system to improve students' learning achievements and motivations in natural science inquiry activities. *Journal of Educational Technology and Society*, *17*(4), 352–365.
[19] Chatzopoulos, D., Bermejo, C., Huang, Z., & Hui, P. (2017). Mobile augmented reality survey: From where we are to where we go. In *IEEE Access*, *5*, 6917–6950. https://doi.org/10.1109/ACCESS.2017.2698164
[20] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c
[21] Terzopoulos, G., & Tsinakos, A. (2020). IPEAR. O1.1 A review of augmented reality tools for building educational experiences (unpublished)
[22] Gayevska, O., & Kravtsov, H. (2022). Approaches on the augmented reality application in Japanese language learning for future language teachers. *Educational Technology Quarterly*, *2022*(2), 105–114. https://doi.org/10.55056/etq.7
[23] Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Integrating augmented reality in language learning: Pre-service teachers' digital competence and attitudes through the TPACK framework. *Education and Information Technologies*, *27*(9), 12123–12146. https://doi.org/10.1007/s10639-022-11123-3

The following section provides an overview of different types of AR applications in general, rather than specifically focusing on language learning.

1.5.1 Marker-based AR

Marker-based AR systems are based on image recognition. Users should point their cameras to visuals and to trigger AR actions. AR markers are codes or symbols that are used to identify and track physical objects in the real world and overlay digital information on top of the real-world environment.[24] Marker-based AR is often used in art exhibitions or textbooks to augment the user's learning experience by adding extra digital content to the 'conventional resource'. The latter can be viewed by the reader either through a smartphone, tablet or personal computer enhanced with a camera. Common types of AR markers (see Figure 4) include:

- *QR codes* (square-shaped black and white patterns that can be read by a camera-equipped device to provide information or launch an action),
- *image markers* (images that are recognised by AR software to trigger a digital overlay, they can be photographs, logos etc.),
- *barcode markers* (a type of AR marker that consists of vertical lines of varying thickness that can be read by barcode scanners or smartphone cameras),
- *location-based markers* (markers that use navigation technology like GPS to trigger AR content when the user enters a specific location),
- *object recognition markers* (computer vision algorithms to recognise and track specific objects in the real world, such as a coffee cup or a chair)
- *audio markers* (sounds that trigger AR content when they are played. They can be used to create interactive soundscapes or trigger specific actions in a game or app).



(a) (b) (c)

Figure 4. *Examples of AR Markers: (a) a QR code (square-shaped black and white patterns that can be read by a camera-equipped device to provide information or launch an action; created with Gemini); (b) an image marker (images that are recognised by AR software to trigger a digital overlay, they can be photographs or logos)[25]; (c) a barcode marker (AR combines a digital layer and the real world; created with Gemini).*

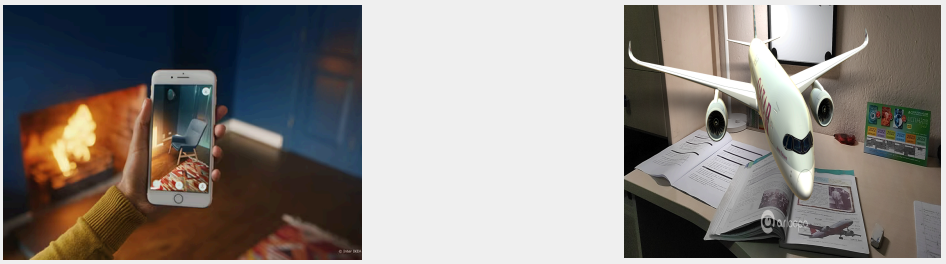
1.5.2 Markerless AR

Markerless AR operates without the need for specific markers. Instead, it relies on the detection of surfaces within the real-world environment to overlay digital 3D content. By analysing the

[24] Berns, A., & Valero-Franco, C. (2024). Embracing transition: The impact of emerging technologies on language learning pedagogies. *Proceedings of the International CALL Research Conference*, *2024*, 15–22. https://doi.org/10.29140/9780648184485-03

[25] https://en.wikipedia.org/wiki/File:App_iSkull,_an_augmented_human_skull.jpg

environment in real-time, marker-less AR technology identifies suitable surfaces, such as tables, floors, walls, or other objects, and accurately anchors virtual content onto them. This allows the digital content to seamlessly integrate with the physical environment, providing an immersive AR experience without the requirement of predefined markers. However, apps that use marker-less AR need significant processing power to detect such unknown surfaces. An example of marker-less AR is the IKEA Place application, which enables the placement of virtual objects - such as items of furniture - inside the user's home or office. This allows users to get a sense of how such items might look in different positions (Figure 5a). Another example of the use of marker-less AR is the one illustrated in Figure 5(b) which shows an augmentation of an object that is introduced in the students' textbook to teach vocabulary and which here is augmented to allow students observe the target object from a close distance. The added value here is that students can learn about objects they usually don't have access to at school.



(a) (b)

Figure 5. *Examples of Marker-less AR: (a) IKEA Place app showing positioned virtual content[26]; (b) Example of marker-less AR to augment an object (in this case an aeroplane from ARloopa)[27].*

1.5.3 Location-based AR

Location-based AR uses the location and sensors of a smart device (i.e., tablet or smartphone) to place the virtual object in the desired location or point of interest.[28,29] This type of AR utilises real-world places to display diverse AR content on the user's device. Users can explore outdoor environments and access a range of location-based AR experiences. Examples of location-based AR content include virtual guides providing historical information about landmarks, interactive maps displaying nearby points of interest, immersive storytelling experiences that unfold based on the user's location, or even location-specific gaming elements where users can interact with virtual objects or characters tied to specific geographic sites. One of the most well-known apps that demonstrates the capabilities of location-based AR is the Pokémon GO smartphone game[30] (Figure 6). This game effectively brings the user's environment to life by displaying various 3D virtual objects, like Pokémon characters, within the viewer's real-world location. This means that as players move around in the real world, their mobile screens show 3D creatures that appear to inhabit the physical space around them. This concept is based on the combination of

[26] IKEA (n.d.). Augmented reality mit der Ikea Place App. Augmented Reality mit der IKEA Place App - IKEA Deutschland. https://www.ikea.com/de/de/this-is-ikea/corporate-blog/ikea-place-app-augmented-reality-puba55c67c0

[27] https://www.arloopa.com/

[28] Punar Özçelİk, N., Ekşİ, G., & Baturay, M. H. (2022). Augmented reality (AR) in language learning: A principled review of 2017–2021. *Participatory Educational Research*, *9*(4), 131–152. https://doi.org/10.17275/per.22.83.9.4

[29] Godwin-Jones, R. (2016). Augmented reality and language learning: From annotated vocabulary to place-based mobile games. *Language Learning and Technology, 20*(3),9–19. https://doi.org/10.125/44475

[30] https://www.pokemon.com/us/app/pokemon-go/

location data and 3D AR technology, allowing digital elements to seamlessly blend with the user's surroundings.

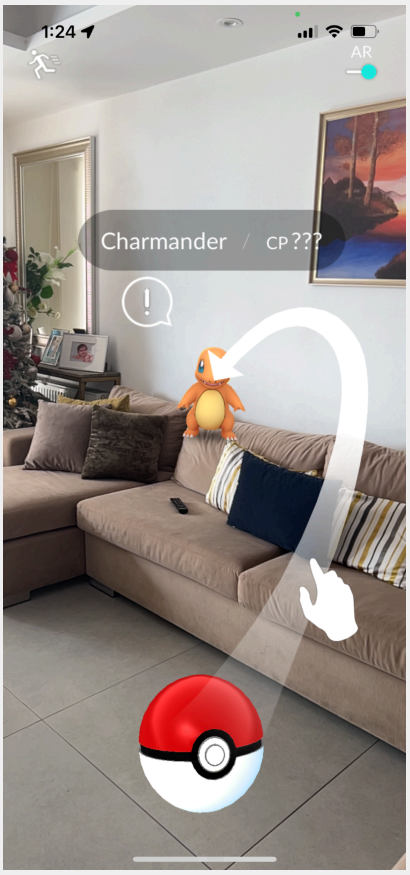


Figure 6. *Example of implementing location-based AR.*[31]

[31] Boiko, O. (2022). All you need to know about location-based augmented reality. https://wear-studio.com/location-based-ar/

Section 2: AR and language learning

2.1 Educational applications of AR in language teaching and learning

AR has emerged as a transformative technology, with immense potential in the field of education and in language learning specifically. From interactive 3D models that dissect complex biological structures to historical reenactments that transport students to bygone eras, AR has opened up new avenues for educators to captivate learners' attention and deepen their understanding. This section delves into the diverse educational applications of AR, showcasing how this technology is revolutionising classrooms and learning environments.

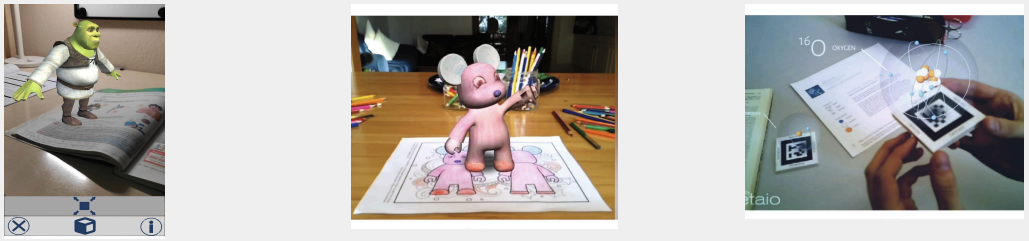
2.1.1 AR books and interactive reading

AR-enhanced books combine printed text and illustrations with digital elements, creating an interactive reading experience. Readers can use AR-enabled devices to scan pages and unlock supplementary content such as animations, 3D models, historical context, or additional explanations. This technology transforms reading into a multisensory adventure that potentially promotes deeper comprehension and engagement[32].

By incorporating AR technology, books can come to life, allowing users to overlay digital content onto the pages. This integration of AR into books requires compatible devices capable of running AR applications. While mobile phones and tablets are commonly used for AR experiences, other devices, such as AR-enabled smart glasses or dedicated AR devices, can also enhance the AR book reading experience. Currently, there are no specific devices that are exclusively designed for AR experiences in books. Most AR applications in books are designed to be compatible with commonly available devices such as smartphones, tablets, and AR-enabled smart glasses. These devices provide the necessary features, such as cameras, displays, and processing power, to support AR interactions with book content. While there may be advancements or specialised devices in the future, the majority of AR book experiences can be accessed through widely used consumer devices.

As illustrated in Figure 7(a-c), one example of augmentation involves enhancing a worksheet with AR, enabling interactive elements, contextual information, or multimedia components to be overlaid onto the physical worksheet. This augmentation aims to provide a more engaging and interactive learning experience, allowing students to access additional resources, such as videos, audio explanations, interactive quizzes, or 3D models, directly within the worksheet. By leveraging marker-based AR in this way, learning materials can be enriched with valuable supplementary information.

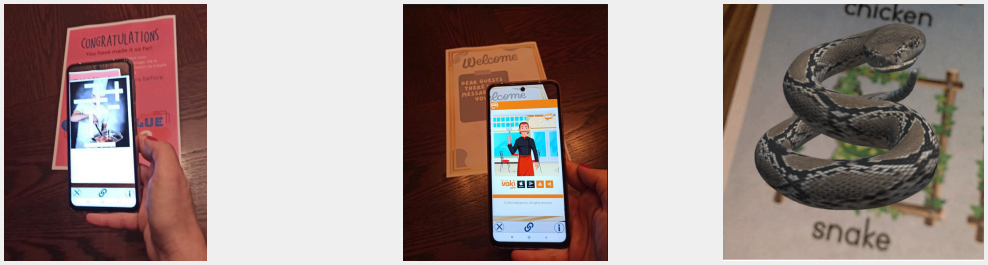
[32]Alsulami, K., Manches, A., & McGeown, S. (2024). Augmented reality books: In-depth insights into children's reading engagement. *Frontiers in Psychology, 15*, Article 1423163. https://doi.org/10.3389/fpsyg.2024.1423163



(a) (b) (c)

Figure 7. *AR applications and books: (a) Learners can access enhanced versions of the imaginary creatures mentioned in their textbook through marker-based AR; (b) Quiver AR colouring application with its pictorial marker; (c) example of marker-based AR displaying 3D atomic models. The 2D barcode (marker) triggers the visualisation of hydrogen and oxygen atoms in three dimensions.* [33]

AR-enhanced books find applications in various fields, including vocabulary learning. In the context of vocabulary acquisition, AR-enhanced books can be utilised through game-based methods, as depicted in Figure 8(a), where a crossword puzzle is augmented with AR content. Additionally, AR can enhance listening skills by utilising the augmentation of avatars, such as the talking avatar (Voki) shown in Figure 7(b), and vocabulary by utilising a game-based method (a crossword in Figure 7(a). On the same line, Karacan (2019)[34] uses a marker-based AR to facilitate vocabulary learning (see Figure 7(c). Further examples can be found in Valero-Franco and Berns (2024).[35]



(a) (b) (c)

Figure 8. *(a) Overlaying a crossword; (b) Talking avatar overlaying printed marker; (c) Example of the use of marker-based AR to illustrate the meaning of a vocabulary item.*[36]

[33] Le, H., & Nguyen, M. (2017). Enhancing textbook study experiences with pictorial bar-codes and augmented reality. In *Computer analysis of images and patterns. Proceedings, Part II* 17: 17th International Conference, CAIP 2017, Ystad, Sweden, August 22–24, 2017 (pp. 139–150). Springer International Publishing.
[34] Karacan, C. G. (2019, April 4). Bringing the dead to life: Vocabulary teaching with augmented reality. *EFL Magazine*. Retrieved February 21, 2023. https://eflmagazine.com/bringing-the-dead-to-life-vocabulary-teaching-with-augmented-reality/
[35] Berns, A., & Valero-Franco, C. (2024). Embracing transition: The impact of emerging technologies on language learning pedagogies. Proceedings of the International CALL Research Conference, 2024, 15–22. https://doi.org/10.29140/9780648184485-03
[36] Karacan, C. G. (2019, April 4). Bringing the dead to life: Vocabulary teaching with augmented reality. *EFL Magazine*. Retrieved February 21, 2023. https://eflmagazine.com/bringing-the-dead-to-life-vocabulary-teaching-with-augmented-reality/

2.1.2 AR for historical storytelling

AR can transport students back in time by overlaying historical scenes onto present-day locations. This immersive approach to history education or to Content and Language Integrated Learning (CLIL) allows learners to experience significant historical events, explore ancient structures, and interact with historical figures, fostering a deeper connection to the past and a more nuanced understanding of historical context (see Figure 9).

The facade reconstruction, linked to a two-dimensional target, can be visualised in real time. It is also possible to make the visualisation interactive by inserting sensitive areas that can show monument information, links to external resources, social sharing links, etc. The test app was created using Unity 3D and an augmented reality plugin named Vuforia (https://www.vuforia.com/).

Figure 9. *Application of AR for historical storytelling.*[37]

2.1.3 Virtual Instructors

Virtual humans, virtual agents or virtual instructors in AR are computer-generated characters that are integrated into a user's real-world environment. The core of a virtual human's functionality is to facilitate social interaction and engagement within an AR context. Virtual Humans combine advanced animation techniques for body and facial expressions with behavioural animation algorithms.[38] They are not merely static digital objects, but rather interactive entities designed to exhibit human-like characteristics and behaviours. These virtual characters can appear as avatars (user-controlled representations) or as embodied agents (autonomous characters with AI-driven behaviours).[39] In language learning, virtual humans serve as practice partners, providing learners with opportunities for authentic, spoken practice in a controlled, risk-free setting. For example, a student can use an AR application to interact with a virtual barista to practise ordering a coffee, or with a virtual tour guide to ask for directions (Figure 10).

[37] Brusaporci, S., Ruggieri, G., Sicuranza, F., & Maiezza, P. (2017, November). Augmented reality for historical storytelling. The INCIPICT project for the reconstruction of the tangible and intangible image of L'Aquila historical centre.In *Proceedings, 60*(1), 1083. MDPI.
[38] Cui, L., & Liu, J. (2023). Virtual human: A comprehensive survey on academic and applications. *IEEE Access, 11*, 123830–123845. https://doi.org/10.1109/ACCESS.2023.XXXXX
[39] Park, S., & Catrambone, R. (2021). Social responses to virtual humans: The effect of human-like characteristics. *Applied Sciences, 11*(16), 7214. https://doi.org/10.3390/app11167214

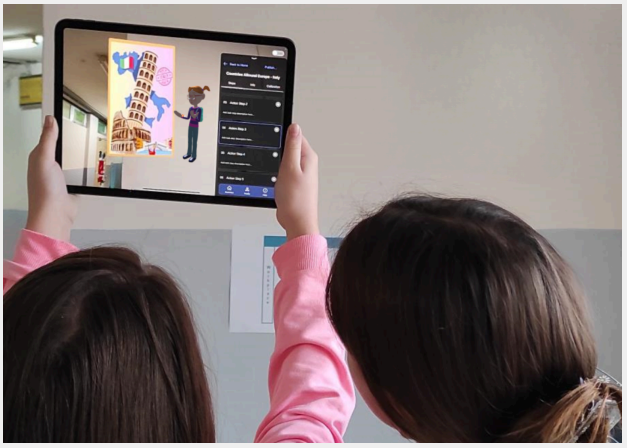


Figure 10. *Example from an AR virtual tour guide activity (Voreopoulou & Parmaxi, 2024).*[40]

These virtual agents or characters are designed to provide interactive experiences that enhance various language skills. For instance, they facilitate simultaneous interaction, often powered by automated speech recognition, allowing learners to have dialogues and receive feedback on their speaking and listening skills (see Figure 11).[41]

Figure 11. *Example from an AI driven virtual instructor to practise Norwegian*[42]

Virtual humans can also enable situational practice in simulated real-world settings, such as navigating a virtual supermarket or guiding a virtual tourist avatar to practise giving and asking for directions.[43]

They are also integrated into game-based learning experiences, where learners interact with avatars to solve problems, complete missions, or engage with new vocabulary and grammar in context.[44] The benefits of using virtual humans in AR applications are extensive: they can significantly increase motivation, engagement, and enjoyment in language acquisition, provide

[40] Voreopoulou, A., & Parmaxi, A. (2024). Exploring augmented reality instruction in the English language classroom. In *The European Conference on Language Learning 2024: Official Conference Proceedings* (pp. 137–150). https://doi.org/10.22492/issn.2188-112X.2024.12
[41] Azimova, D., & Solidjonov, D. (2023). Learning English language as a second language with augmented reality. *Qo 'Qon Universiteti Xabarnomasi*, 1, 112-115.
[42] https://youtu.be/7sle4u3tuOI
[43] Azimova, D., & Solidjonov, D. (2023). Learning English language as a second language with augmented reality. *Qo 'Qon Universiteti Xabarnomasi,* 1, 112-115.
[44] Shadiev, R., & Liang, Q. (2024). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching, 18*(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804

real-world context and authentic learning experiences by connecting digital content to physical environments, offer immediate feedback to learners, allow for personalised and adaptive learning, and can make abstract concepts more tangible and comprehensible. By offering a safe space to make mistakes and receive immediate feedback, these virtual agents help build the confidence and fluency necessary for successful real-world communication. Applications like MondlyAR allow learners to place virtual characters in their own environment and engage in conversational practice, offering a low-stakes way to build confidence before real-world interactions (see Figure 12).

In each of these applications, AR enriches the learning experience by engaging multiple senses, creating immersive environments, and providing dynamic, interactive content that fosters understanding and retention. AR's ability to merge the virtual and physical worlds offers educators innovative tools to enhance their teaching methods and empower students to explore and learn in new and exciting ways.

Figure 12. *Mondly AR for language learning.*[45]

2.2 The benefits of AR in language teaching and learning

The use of AR holds significant promise for language learning.[46] Although research in this area is still in its early stages,[47] the most frequently mentioned advantages of AR in language instruction include enhanced learner motivation and engagement. This is attributed, in part, to the entertaining and educational environment that AR creates.[48,49]

A recent meta-analysis on the use of AR for language learning has demonstrated that AR applications have a significant, positive, medium influence on both linguistic gains and affective

[45] Mondly AR https://www.androidheadlines.com/2018/03/mondlyar-app-combines-language-learning-with-googles-arcore.html
[46] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education*, *4*(2), 27–43. https://doi.org/10.26417/501ibq23c
[47] Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning, 36*(6), 861-875. https://doi.org/10.1111/jcal.12486
[48] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education*, *4*(2), 27–43. https://doi.org/10.26417/501ibq23c
[49] Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review, 20*, 1-11. https://doi.org/10.1016/j.edurev.2016.11.002

gains in language learning. Regarding linguistic gains, language skills and intervention duration were identified as significant moderators. Vocabulary and reading showed large effect sizes, and interventions lasting up to half a year had the largest impact. For affective gains, educational level, target language, language skills, and L1/L2 were significant moderators. Elementary school students and preschool students experienced large effects, as did vocabulary learning.[50] Beyond linguistic gains and affective gains, AR has been shown to alleviate learner anxiety, boost confidence, and increase satisfaction when completing tasks.[51] These positive outcomes are often associated with the immersive and interactive nature of AR, which provides simulated real-life learning experiences. Additionally, AR is noted for its contribution to improved cultural awareness and the development of essential 21st-century skills. One noteworthy aspect is how AR supports embodied active learning in more realistic learning contexts. This hands-on, experiential approach further enhances the learning experience for students.[52, 53]

In summary, incorporating AR into language learning not only makes the learning process more enjoyable but also contributes to the development of crucial language skills for students.[54,55,56] In the section that follows we elaborate on the key benefits of AR in language teaching and learning with relevant examples.

2.2.1 Engaging and interactive learning environment

AR creates a highly engaging and interactive learning environment by overlaying digital content onto the physical world. This multi-sensory experience can lead to increased student motivation, attention, enjoyment, and cognitive engagement compared to traditional teaching methods.[57] For example, the study of Azimova and Solidjonov (2023) found that an experimental group using an AR application showed a statistically significant improvement in English language proficiency and demonstrated a higher level of engagement and motivation compared to a control group using traditional methods such as textbooks and audio recordings. The AR application provided an immersive and interactive learning experience that encouraged learners to practice their language skills more frequently and for longer periods. Moreover, according to Solak and Cakir (2015)[58], the motivation to use AR technology is not affected by gender. Combined with the fact that many children own a smartphone (e.g., in the UK, 58% of 8-11

[50] Wu, J., Jiang, H.,& Chen, S. (2024). Augmented reality technology in language learning: A meta-analysis. *Language Learning & Technology,* 28(1), 1–23. https://hdl.handle.net/10125/73596
[51] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c
[52] Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861-875. https://doi.org/10.1111/jcal.12486
[53] Pegrum, M. (2021). *Augmented reality learning.* Innovative language pedagogy report, 115.
[54] Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review, 20*, 1-11. https://doi.org/10.1016/j.edurev.2016.11.002
[55] Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861-875. https://doi.org/10.1111/jcal.12486
[56] Punar Özçelİk, N., Ekşİ, G., & Baturay, M. H. (2022). Augmented reality (AR) in language learning: A principled review of 2017–2021. *Participatory Educational Research*, *9*(4), 131–152. https://doi.org/10.17275/per.22.83.9.4
[57] Azimova, D., & Solidjonov, D. (2023). Learning English language as a second language with augmented reality. *Qo ‘Qon Universiteti Xabarnomasi,* 1, 112-115.
Wen, Y. Augmented reality enhanced cognitive engagement: designing classroom-based collaborative learning activities for young language learners. *Education Tech Research Dev,* 69, 843–860 (2021). https://doi.org/10.1007/s11423-020-09893-z
[58] Solak, E., & Cakir, R. (2015). Exploring the effect of materials designed with augmented reality on language learners’ vocabulary learning. *Journal of Educators Online*, *12*(2), 50–72. https://doi.org/10.9743/JEO.2015.2.5

year-olds own a smartphone, 90% at the age of eleven)[59], AR could create an extension for teaching and learning with relatively low entrance barriers.

2.2.2 Real-world context supporting situated learning

AR provides real-world context and supports situated learning by enabling language learning to extend beyond the classroom into authentic, real-world scenarios by presenting learners with meaningful objects and situations from their daily lives.[60] A study used Pokémon Go, a location-based AR mobile game, where learners visited real places to "catch" Pokémon and simultaneously practiced newly learned English suffixes, prefixes, and infixes.[61] Another example involved L2 learners following AR-triggered images placed in their classroom, where students interacted with animations and media as they improved their language skills.[62]

2.2.3 Enhancement of language skills

Research suggest that AR may improve the performance of specific language components and competences, [63,64,65,66] particularly among learners who have previously struggled (see section 3.1 below). [67,68] Research has shown that AR enhances language skills (vocabulary, pronunciation, reading, listening, writing, grammar) by offering interactive and multimodal learning content. In vocabulary, for instance, AR has proven to be particularly effective in improving both learning and retention, with one study reporting that the immersive AR experience of learning with virtual labels on real-world objects is more effective with improved recall tests for participants compared to flashcards.[69] This is also corroborated by Khazali et al. (2023)[70] who noted the potential of AR to facilitate memorisation due to the additional

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[59] Statista (2022). Share of children owning mobile phones in the United Kingdom (UK) as of December 2021, by age group. https://www.statista.com/statistics/1326211/children-owning-mobile-phone-by-age-uk/.
[60] Shadiev, R., & Liang, Q. (2024). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78-100.
[61] Wu, M. H. 2021. "The Applications and Effects of Learning English Through Augmented Reality: A Case Study of Pokémon Go." *Computer Assisted Language Learning* 34 (5-6): 778–812. https://doi.org/10.1080/09588221.2019.1642211
[62] Parlar, B., & Sütçü, S. S. (2025). The effects of augmented reality in situated English language learning. *Journal of Computer Assisted Learning, 41*(3), e70041. https://doi.org/10.1111/jcal.70041
[63] Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review, 20*, 1-11. https://doi.org/10.1016/j.edurev.2016.11.002
[64] Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861-875. https://doi.org/10.1111/jcal.12486
[65] Punar Özçelİk, N., Ekşİ, G., & Baturay, M. H. (2022). Augmented reality (AR) in language learning: A principled review of 2017–2021. *Participatory Educational Research*, *9*(4), 131–152. https://doi.org/10.17275/per.22.83.9.4
[66] Berns, A., & Valero-Franco, C. (2024). Embracing transition: The impact of emerging technologies on language learning pedagogies. *Proceedings of the International CALL Research Conference*, 2024, 15–22. https://doi.org/10.29140/9780648184485-03
[67] Freitas, R., & Campos, P. (2008). SMART: A SysteM of augmented reality for teaching 2nd grade students. In *Proceedings of the 22nd British HCI Group Annual Conference on People and Computers: Culture, Creativity, Interaction*, *2* (pp. 27–30). Swinton, UK, UK.
[68] Karacan, C. G., & Akoğlu, K. (2021). Educational augmented reality technology for language learning and teaching: A comprehensive review. *Shanlax International Journal of Education*, *9*(2), 68–79. https://doi.org/10.34293/education.v9i2.3715
[69] Ibrahim, A., Huynh, B., Downey, J., Höllerer, T., Chun, D., & O'Donovan, J. (2018). Arbis pictus: A study of vocabulary learning with augmented reality. *IEEE Transactions on Visualization and Computer Graphics, 24*(11), 2867–2874. https://doi.org/10.1109/TVCG.2018.2848005
[70] Khazali, N. A., Ismail, I., Sakamat, N., Zain, N. H. M., Noh, N. A. M., & Ishak, N. H. (2023). Smart pictorial dictionary via mobile augmented reality. *Bulletin of Electrical Engineering and Informatics, 12*(2), 1019–1028. https://doi.org/10.11591/eei.v12i2.4774

provision of useful spatialised information. Similarly, Geng and Yamada (2020)[71] developed an AR learning system to help students acquire complex Japanese compound verbs. The system used scannable verb cards and a smartphone app to display animations, a method designed to clarify verb meanings. Their study found that this AR system positively supported compound verb learning and effectively enhanced learners' knowledge retention. The use of AR in language learning also supports learners with special needs to acquire vocabulary in a foreign language or improve their pronunciation skills[72].

AR also directly benefits pronunciation; built-in speech recognition in some AR apps provides immediate feedback, while filters in apps like B612 can help L2 students improve articulatory awareness and reduce shyness, encouraging consistent practice.[73] Furthermore, studies indicate that AR improves reading and comprehension skills, with children using AR storybooks showing significantly better reading comprehension than those using print versions.[74] Another application for L2 reading is Google Lens which enables to superimpose translations on a text, and L2 learners can practise second language reading and vocabulary in an interactive way.[75] Regarding writing, AR can enrich learning content and foster creativity, yet its impact on supporting learners in terms of linguistic accuracy remains a challenge. In some studies, AR is used to allow language learners to bring their writings to life, for example by enabling them to design stories and animate them through an AR platform.[76] Learners in AR environments often focus on the interactive process and content rather than on linguistic resources like word choice, a key component of quality writing.[77] This has led some researchers to suggest that traditional, paper-based writing may outperform AR-supported methods when the goal is to improve word choice and sentence variation.[78] Similarly, while AR can be used to teach grammar by superimposing rules onto real-world objects, some studies have shown mixed results in performance, despite an increase in student motivation.[79] Finally, a recent study with a focus on reading has shown that an AR-supported reading activity facilitates students' reorganisation and inferential comprehension[80] .

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[71] Geng, X., & Yamada, M. (2020). An augmented reality learning system for Japanese compound verbs: Study of learning performance and cognitive load. *Smart Learning Environments, 7*(1), 27. https://doi.org/10.1186/s40561-020-00137-2

[72] Hashim, H. U., Yunus, M. M., & Norman, H. (2022). 'AReal-Vocab': An augmented reality English vocabulary mobile application to cater to mild autism children in response towards sustainable education for children with disabilities. *Sustainability, 14*(8), 4831. https://doi.org/10.3390/su14084831

[73] Zhu, J., Zhang, X., & Li, J. (2024). Using AR filters in L2 pronunciation training: Practice, perfection, and willingness to share. *Computer Assisted Language Learning, 37*(5–6), 1364–1396. https://doi.org/10.1080/09588221.2022.2080716

[74] Danaei, D., Jamali, H. R., Mansourian, Y., & Rastegarpour, H. (2020). Comparing reading comprehension between children reading augmented reality and print storybooks. *Computers & Education, 153*, 103900. https://doi.org/10.1016/j.compedu.2020.103900

[75] Kaplan-Rakowski, Regina and Papin, Kevin, Augmented Reality-Assisted Language Learning (ARALL) (May 01, 2024). Available at SSRN: https://ssrn.com/abstract=4894258 or https://doi.org/10.2139/ssrn.4894258

[76] Caruana, L. F., Busuttil, L., Żammit, J., Parmaxi, A., Christou, E., Ioannou, A., ... & Martínez, L. A. (2025, June). Children as Creators of Augmented Reality Stories: A Constructionist Approach to Language Learning. In Constructionism Conference Proceedings (Vol. 8, pp. 451-458). https://constructionism.oapublishing.ch/article/view/40/40

[77] Koc, O., E. Altun, and H. Yuksel. 2022. "Writing an Expository Text Using Augmented Reality: Students' Performance and Perceptions." *Education and Information Technologies,* 27 (1), 845–866. https://doi.org/10.1007/s10639-021-10438-x.

[78] Yang, P., & Zhang, W. (2025). Effectiveness of augmented reality on EFL learners' language gains: A meta-analysis. *Innovation in Language Learning and Teaching, 19*(1), 48–63.

[79] Marrahi-Gomez, V., & Belda-Medina, J. (2024, May). Assessing the effect of augmented reality on English language learning and student motivation in secondary education. *Frontiers in Education, 9*, 1359692. https://doi.org/10.3389/feduc.2024.1359692

[80] Cai, Y., Pan, Z., & Liu, M. (2022). Augmented reality technology in language learning: A meta-analysis. *Journal of Computer Assisted Learning, 38*(4), 929–945. https://doi.org/10.1111/jcal.12661

2.2.4 Reduction of student anxiety

A key benefit of AR, which facilitates all of the aforementioned skill improvements, is its ability to mitigate negative psychological factors like anxiety and shyness that often impede language learning, especially speaking practice. By providing a low-risk, engaging environment for students to practice without fear of judgment, AR empowers learners to build confidence and fluency. In pronunciation training, AR filters effectively reduced learners' embarrassment and shyness when faced with corrective feedback from teachers, making them more willing to record and upload practice videos.[81]

2.2.5 Offering of Personalised and Adaptive Learning

AR technology provides tailored learning experiences that can adjust to individual needs. This includes immediate, adaptive, and personalised learning support.[82] For example, the StemUp application allows English as a Foreign Language (EFL) instructors to personalise AR-integrated courses based on students' proficiency levels, providing adaptive challenges and continuous feedback.[83] AR may also support a practical object labelling system that identifies objects in the world in real time, and incorporates a personalised learning model that dynamically adapts to student's growth.[84]

2.2.6 Facilitation of Interaction and Collaboration

AR entails potential to foster increased interaction among learners, with the learning content, and with peers, promoting collaborative problem-solving and social engagement.[85] Furthermore, AR has been linked to increased interaction among students and between students and teachers. This heightened level of engagement fosters a dynamic learning environment. For example, in an AR-based mobile game, students could team up to complete assigned tasks while playing the game and learning the language simultaneously, leading to increased interactions with their partners.[86] AR applications for English language objects and environments also enable interaction. An AR escape room game, "LockED in ShakespeARe's Globe Theatre," incorporates cooperative team play and collaborative activities, contributing to an immersive language learning experience.[87]

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[81] Zhu, J., Zhang, X., & Li, J. (2024). Using AR filters in L2 pronunciation training: Practice, perfection, and willingness to share. *Computer Assisted Language Learning, 37*(5–6), 1364–1396. https://doi.org/10.1080/09588221.2022.2080716

[82] Hsu, K. C., Barrett, N. E., & Liu, G. Z. (2023). English for tourism and AR-assisted context-aware ubiquitous learning: a preliminary design-based research study. *Computer Assisted Language Learning*, *38*(3), 544–568. https://doi.org/10.1080/09588221.2023.2202701

[83] Lin, H. Y., & Tsai, S. C. (2021). Student perceptions towards the usage of AR-supported STEMUP application in mobile courses development and its implementation into English learning. *Australasian Journal of Educational Technology, 37*(3), 88–103. https://doi.org/10.14742/ajet.6408.

[84] Huynh, B., Orlosky, J., & Höllerer, T. (2019, March). In-situ labeling for augmented reality language learning. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)* (pp. 1606–1611). IEEE. https://doi.org/10.1109/VR.2019.8798262

[85] López-Faican, L., & Jaen, J. (2020). EmoFindAR: Evaluation of a mobile multiplayer augmented reality game for primary school children. *Computers & Education, 149*, 103814. https://doi.org/10.1016/j.compedu.2020.103814

[86] Perry, B. (2022). Collaborative learning via mobile language gaming and augmented reality: affordances and limitations of technologies (Doctoral dissertation).

[87] Voreopoulou, A., Mystakidis, S., & Tsinakos, A. (2024). Augmented reality escape classroom game for deep and meaningful English language learning. *Computers, 13*(1), 24. https://doi.org/10.3390/computers13010024

2.2.7 21-st century skills

AR can help students develop 21-st century skills by giving them opportunities to design and build their own AR content, thereby actively contributing to the learning process and improving expressive skills. For example, students can create their own AR content, such as storyboards, presentations, or AR-based art projects, which helps improve their expression skills in the target language. Learners can also create AR artifacts like videos, brochures, or presentations. For example in the study of Lee and Park (2020), students used a location-based AR application in groups to create scenes using the target language in a real-life context. They then played others' scenes either individually or in groups outside the classroom.[88]

Working in groups with AR can strengthen students' social skills, helping them communicate and collaborate and even form new friendships.[89] Finally, AR can support students to learn the target language autonomously, develop time management skills, finish the lesson task on time, choose language activities they can do on their own, know and correct their mistakes and reduce their dependence on teachers' guidance.[90]

Figure 13 summarises the benefits of AR in language learning.

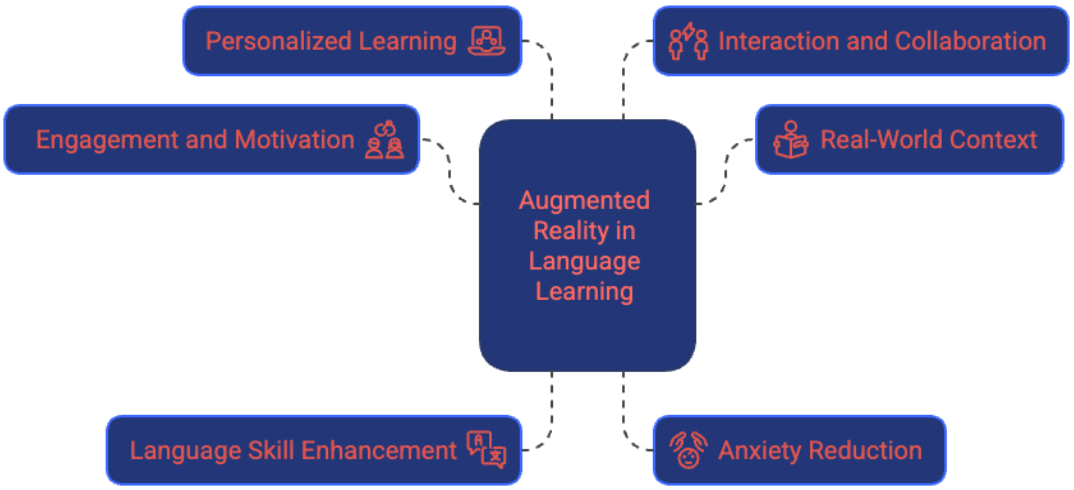

Figure 13. *Summary of benefits of AR in language learning (own figure created with Napkin.ai).*

2.3 The challenges of applying AR to language teaching

Despite its potential benefits, the application of AR technology to language teaching

[88] Lee, S.-M., & Park, M. (2020). Reconceptualization of the context in language learning with a location-based AR app. *Computer Assisted Language Learning*, 33(8), 936–959. https://doi.org/10.1080/09588221.2019.1602545
[89] Zhang, S. (2021). Integrating Augmented Reality into a Task-Based Thematic Language Teaching Unit. *Journal of Technology and Chinese Language Teaching*, 12(2), 29–48.
[90] Aldossari, S., & Alsuhaibani, Z. (2021). Using augmented reality in language classrooms: The case of EFL elementary students. *Advances in Language and Literary Studies, 12*(6), 1–8. https://doi.org/10.7575/aiac.alls.v.12n.6p.1.

poses a number of challenges (see Figure 14)[91, 92, 93].

2.3.1 Technical challenges

Teachers may encounter several technical challenges when integrating AR into their lessons. Common issues include unreliable internet connection and large storage requirements of many AR apps. In addition, the literature also reports the inaccuracy of the sensor-based detection of location and the complexity and usability of the technology[94]. These challenges may result in teachers' and students' being discouraged from using AR technologies for teaching-learning purposes.[95] These challenges are particularly noticeable in location-based AR applications. A GPS (Global Positioning System) error may occur due to an AR application's misinterpretation of a location or directional data.[96,97] Other issues that might be a challenge when implementing AR in the classroom are the often small screen size of the mobile device used or the need for internet connectivity which is not always available.[98]

The development of an AR environment is a highly iterative process, and requires many adjustments in the final stages, especially when elements are location-based. The only way for instructors to verify updates and changes to location-based AR triggers is by physically going to each location and testing them.[99]

2.3.2 Complexity and Cognitive load

In the context of AR, the concept of cognitive load refers to the mental effort and resources required by learners to process information while engaging in AR tasks. Some AR tasks have been observed to be overly demanding and complex, placing a heavy burden on learners' cognitive capacities. When tasks are too complex, learners may find it challenging to effectively process and integrate the augmented information presented to them. This heavy cognitive load can have negative consequences on both the learning experience and the motivation of the learners. Essentially, if the demands of an AR task surpass a learner's cognitive capacity, it can lead to frustration, decreased motivation, and potentially hinder the overall effectiveness of the learning experience. Research also suggests that the AR applications in the classroom could be a

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[91] Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review, 20*, 1-11. https://doi.org/10.1016/j.edurev.2016.11.002

[92] Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861-875. https://doi.org/10.1111/jcal.12486

[93] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c

[94] Ustun, A. B., Simsek, E., Karaoglan-Yilmaz, F. G., & Yilmaz, R. (2022). The effects of AR-enhanced English Language Learning Experience on Students' Attitudes, Self-Efficacy and Motivation. *TechTrends*, 66(5), 798–809. https://doi.org/10.1007/s11528-022-00757-2

[95] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c

[96] Chiang, T. H., Yang, S. J., & Hwang, G. J. (2014). An augmented reality-based mobile learning system to improve students' learning achievements and motivations in natural science inquiry activities. *Journal of Educ. Tech. & Society*, *17*(4), 352-365.

[97] Akçayır, M., & Akçayır, G. (2017). Advantages and challenges associated with augmented reality for education: A systematic review of the literature. *Educational Research Review, 20*, 1-11. https://doi.org/10.1016/j.edurev.2016.11.002

[98] Pegrum, M. (2021). *Augmented reality learning.* Innovative language pedagogy report, 115.

[99] Perry, B. (2021). Gamified Mobile Collaborative Location-Based Language Learning. *Frontiers in Education*, 6. https://doi.org/10.3389/feduc.2021.689599

distraction factor for learners in the classroom.[100] Also, learners often feel that they need someone more knowledgeable to guide them on what to do to learn more effectively. Requiring a tutor to assist students in order to use the AR model has negatively influenced learners' feelings because they felt that using this AR application required a more knowledgeable person to support them.[101]

Therefore, it becomes crucial for educators to carefully design AR activities, ensuring that they strike a balance between providing a meaningful learning experience and avoiding an excessive cognitive load. This involves considering the complexity of the AR content, the learners' prior knowledge, and the overall learning objectives to optimise engagement and facilitate effective learning.[102,103]

2.3.3 Limited training and exposure to AR technology

Teachers often encounter difficulties when they lack the expertise to effectively incorporate AR tools into their teaching methods. The necessity of instructors' training in AR content creation and development, as well as knowledge of basic digital skills in order to work with advanced educational technologies is a requirement.[104] Due to the lack of training and expertise of instructors on the design and development of AR activities, as well as issues faced such as mobile availability, software compatibility, interface design, user-friendly implementation and pricing, AR can become a complex task.[105] Some other limitations from instructors' perspectives pertain to the content creation, especially with editing and publishing options, as well as frustration during the teaching experience because of low image sensitivity and recognition, scan limitations, limited hardware and poor connectivity in some spaces.[106] In addition to issues teachers face, students may also complain that they are unfamiliar with the operation of AR. In a study by Chien (2019) students expressed a lot of negative emotions and failures. Some students selected beautiful scenic or vague images for their AR markers that were too complicated to trigger the augmented videos or pictures as they wished.[107] Other participants with no experience before in a digital environment stated that they struggled with comprehension and

[100] Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Integrating augmented reality in language learning: pre-service teachers' digital competence and attitudes through the TPACK framework. *Education and Information Technologies*, 27(9), 12123–12146. https://doi.org/10.1007/s10639-022-11123-3
Binhomran, K., & Altalhab, S. (2021). The impact of implementing augmented reality to enhance the vocabulary of young EFL learners. *JALT CALL Journal*, 17(1), 23–44. https://doi.org/10.29140/JALTCALL.V17N1.304
[101] Ebrahimi, M. (2022). Ubiquitous learning: the effect of LingAR application on EFL learners' language achievement and the realization of their motivation towards mobile learning. *Interactive Learning Environments*. https://doi.org/10.1080/10494820.2022.2041044
[102] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c
[103] Pegrum, M. (2021). *Augmented reality learning.* Innovative language pedagogy report, 115.
[104]Dukalskaya, I. V., & Tabueva, I. N. (2022). Promoting augmented reality technology in teaching English language to non-linguistic students in higher education. *European Journal of Contemporary Education, 11*(1), 47–58. https://doi.org/10.13187/ejced.2022.1.47
[105] Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Integrating augmented reality in language learning: pre-service teachers' digital competence and attitudes through the TPACK framework. *Education and Information Technologies*, 27(9), 12123–12146. https://doi.org/10.1007/s10639-022-11123-3
[106] Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Integrating augmented reality in language learning: pre-service teachers' digital competence and attitudes through the TPACK framework. *Education and Information Technologies*, 27(9), 12123–12146. https://doi.org/10.1007/s10639-022-11123-3
[107] Chien, C. (2019). English for ecotourism and its sustainability with augmented reality technology. *International Education Studies, 12*(6), 134–147. https://doi.org/10.5539/ies.v12n6p134

this encouraged the instructors to make adjustments in order to simplify the gameplay options by inserting additional hints, and creating tutorial videos (Perry, 2021).[108]

To overcome this challenge, comprehensive training programs need to equip educators and students with the required skills and knowledge. There is a need to ensure that they both have the skills required to integrate AR into their language learning environments, through training opportunities and the availability of suitable resources.[109]

2.3.4 Limited scope

A key challenge for the field of language instruction is that, despite ongoing advances in research, very little is known as to how this process unfolds and what can best support it. Nevertheless, numerous instructional resources already exist - be they online or offline, individual or interactive - at multiple levels and for a range of contexts - that currently contribute to effective language teaching and learning. It is therefore important to consider the extent to which AR can notably enhance what already exists, particularly bearing in mind the associated costs. Moreover, where there appear to be novel opportunities for enhancing language instruction through AR, the technology is currently insufficiently well developed to begin to address them at present.

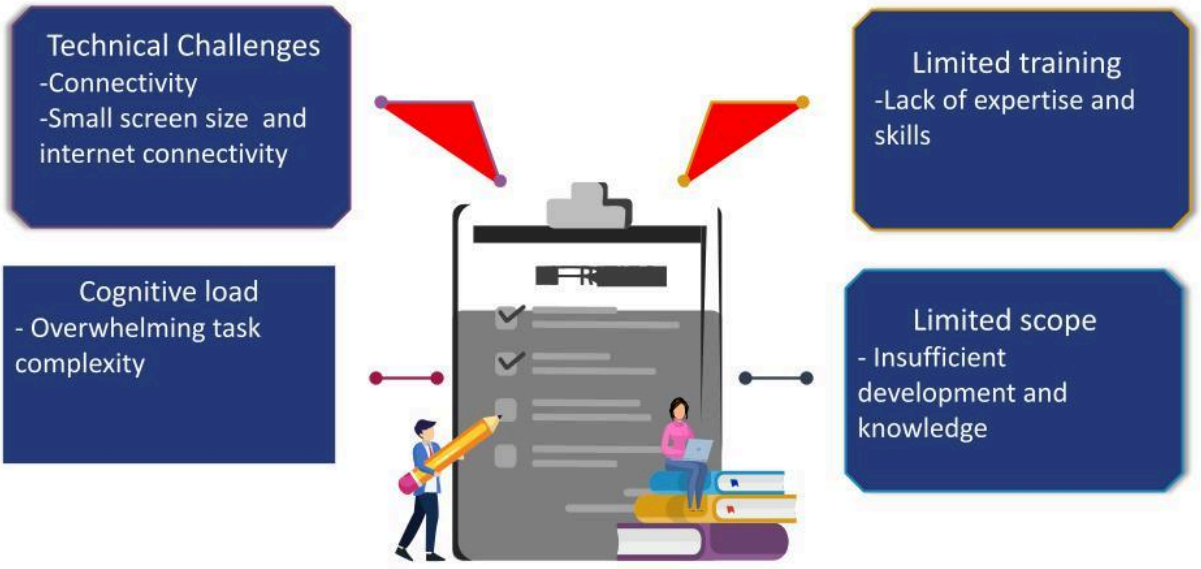


Figure 14. *Challenges associated with the application of AR to language learning (own figure).*

2.4 Language components that may be enhanced with AR-mediated instructional materials

Language may be described as a complex integrated communicative system composed of a number of discrete components. Attributing one name is challenging, but, for the purpose of this guide, we distinguish these components as follows:

[108] Perry, B. (2021). Gamified Mobile Collaborative Location-Based Language Learning. *Frontiers in Education*, 6. https://doi.org/10.3389/feduc.2021.689599
[109] Punar Özçelİk, N., Ekşİ, G., & Baturay, M. H. (2022). Augmented reality (AR) in language learning: A principled review of 2017–2021. *Participatory Educational Research*, *9*(4), 131–152. https://doi.org/10.17275/per.22.83.9.4

Table 1. Linguistic elements and communicative modes may be enhanced with AR-mediated instructional materials

Linguistic elements	Communicative modes
- Vocabulary - Pronunciation - Morphology - Grammar - Phraseology - Pragmatics	- Listening - Speaking - Reading - Writing

While it can be helpful to focus on these components of language separately in language lessons and materials, they very rarely occur in isolation in real-life communication. We, therefore, recommend that language learning tasks – whether conventional or AR-mediated - are designed to mimic authentic, meaningful communication involving multiple linguistic elements and modes.

In the following subsections, we describe the above linguistic components in turn, with reference to existing studies of the deployment of AR in different educational settings. We are conscious, however, of the limited number and scale of the studies undertaken in this area to date. Further evidence is, therefore, required to substantiate any claims made for the benefits of using AR in language instruction over and above those achieved using the multiple instructional resources and approaches already available to educators and learners.

2.5 Linguistic elements

2.5.1 Vocabulary

Vocabulary refers to the words or lexicon items of a particular language. These are often classified into sub-elements such as nouns, verbs, adjectives, adverbs, articles, and pronouns. AR supports vocabulary learning mainly by offering opportunities to the students to visualise words in context (Berns & Valero-Franco, 2025, see Figure 15).[110]

[110] Berns, A., & Valero-Franco (2025). From users to creators: Harnessing Extended Reality and End-User Development tools in Language Education. In A. Alm, C. Lai, & A. Ma (Eds.), *Transitions in CALL*, Castledown Publisher. *Transitions in CALL*. Castledown Publishers. https://doi.org/10.29140/9781914291272 (forthcoming).

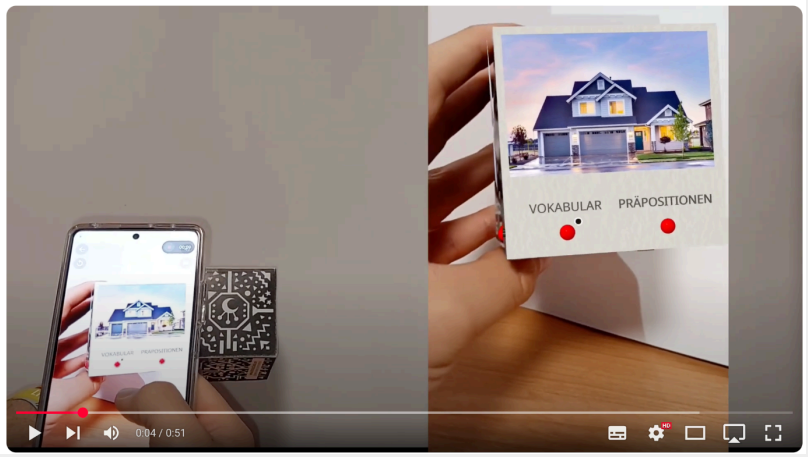


Figure 15. *Example for a vocabulary and grammar learning AR app (Objects and Prepositions)* *https://youtu.be/TdlhsvG8HKA?feature=shared*

To date, vocabulary has received the most attention in terms of the application of AR - as well as VR - to language instruction. This is most likely because shifting attention to tangible objects and deploying AR to enrich them with interactivity and at the same time situate them in real-life context can be achieved through multiple software applications (e.g. Delightex, ARtutor, Quiver, ARLoopa, ARanimals, Blippar). These applications often do not require demanding and complex programming, although some, such as UNITY, do require coding skills.

AR games and AR-based flashcards or activities are often employed to design sound, text, images, and animations to teach new vocabulary items that relate to real objects in the environment. Previous studies using the Cognitive Theory of Multimedia Learning (CTML) have shown that when unknown words were annotated with both text (translations) and pictures (images or videos), the latter were retained better in post-tests than words annotated with text alone (e.g., [111,112,113,114]). Scrivner et al. (2016),[115] for instance, used photos as triggers, each of which was augmented with a video of a mini-dialogue or video, helping students to retain new vocabulary items, and its associated pronunciation in context (see Figure 16). Similarly, Ibrahim et al. (2018)[116] displayed label annotations on objects and voice commands, mediated by AR smart glasses, Microsoft HoloLens, to examine productive recall compared to the use of traditional flashcards. They report that learners perceived the AR experience to be more

[111] Santos, M. E. C., Lübke, A. I. W., Taketomi, T., Yamamoto, G., Rodrigo, M. M. T., Sandor, C., & Kato, H. (2016). Augmented reality as multimedia: The case for situated vocabulary learning. *Research and Practice in Technology Enhanced Learning*, *11*(1), 4. https://doi.org/10.1186/s41039-016-0028-2

[112] Tobar-Muñoz, H., Baldiris, S., & Fabregat, R. (2017). Augmented reality game-based learning: Enriching students' experience during reading comprehension activities. *Journal of Educational Computing Research*, *55*(7), 901–936. https://doi.org/10.1177/0735633116689789

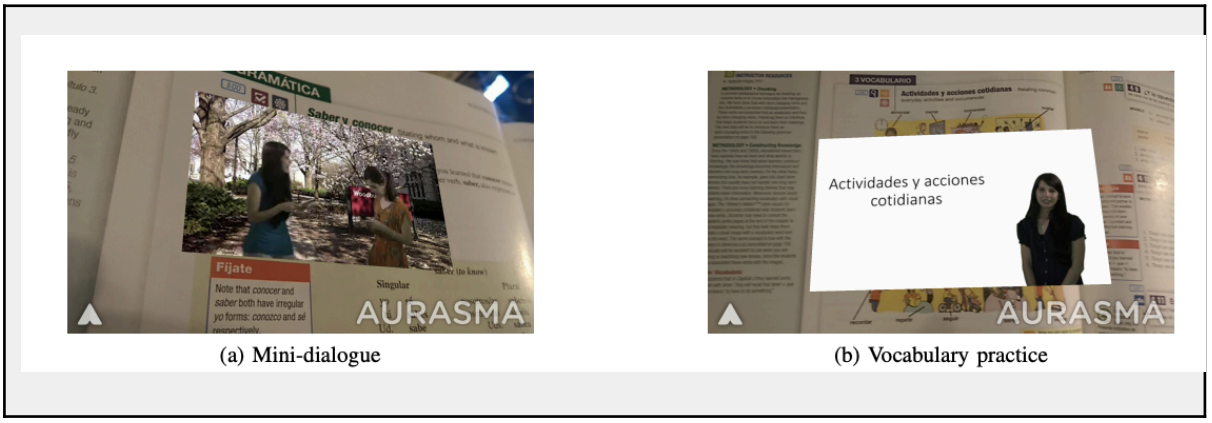
[113] Hsu, T. C. (2019). Effects of gender and different augmented reality learning systems on English vocabulary learning of elementary school students. *Universal Access in the Information Society*, *18*(2), 315–325. https://doi.org/10.1007/s10209-017-0593-1

[114] Chien, C. Y. (2019). English for ecotourism and its sustainability with augmented reality technology. *International Education Studies, 12*(6), 134–147. https://doi.org/10.5539/ies.v12n6p134

[115] Scrivner, O., Madewell, J., Buckley, C., & Perez, N. (2016, December). Augmented reality digital technologies (ARDT) for foreign language teaching and learning. In *Future Technologies Conference (FTC)* (pp. 395–398). IEEE Publications. https://doi.org/10.1109/FTC.2016.7821639

[116] Ibrahim, A., Huynh, B., Downey, J., Höllerer, T., Chun, D., & O'Donovan, J. (2018). ARbis Pictus: A study of vocabulary learning with augmented reality. *IEEE Transactions on Visualization and Computer Graphics, 24*(11), 2867–2874. https://doi.org/10.1109/TVCG.2018.2868568

constructive and enjoyable than the use of conventional flashcards. AR-enhanced flashcards are used as part of the MARVL[117] AR-mediated instructional tool that deploys marker-based AR to enable children to scan flashcards and interact with avatars while building new vocabulary (see Smith et al., 2023[118]).



(a) Mini-dialogue (b) Vocabulary practice

Figure 16. *Trigger image combined with a specific video overlay. Each trigger image is combined with a specific video overlay. The figure illustrates auras (overlays) as they are seen from the user's mobile device. The mini-dialogue helps retain new vocabulary and grammatical constructions in context, whereas vocabulary practice provides visual and audio reinforcement* [119]

However, despite the promise of these initial findings on vocabulary retention [120,121] and motivation,[122, 123] these studies have limitations of research design and methodological issues. For example, many studies are conducted with small sample sizes which can limit the generalisability of the findings regarding the learning effectiveness of AR, as well as the duration of experimental teaching that is often short making it difficult to assess long-term vocabulary retention.[124]

In another study, Barreira et al. (2012)[125] used game-based learning and more precisely Matching Objects and Words (MOW) to examine Portuguese and English learning among

[117] https://marvllanguage.com/
[118] Smith, S., Carlo, M., Park., S. & Kaplan, H. (2023). Exploring the promise of Augmented Reality for dual language vocabulary learning among bilingual children: a case study. *CALICO Journal*, 40(1), 91-112. https://doi.org/10.1558/cj.22757
[119] Scrivner, O., Madewell, J., Buckley, C., & Perez, N. (2016, December). Augmented reality digital technologies (ARDT) for foreign language teaching and learning. In *Future Technologies Conference (FTC)* (pp. 395–398). IEEE Publications. https://doi.org/10.1109/FTC.2016.7821639
[120] Santos, M. E. C., Lübke, A. I. W., Taketomi, T., Yamamoto, G., Rodrigo, M. M. T., Sandor, C., & Kato, H. (2016). Augmented reality as multimedia: The case for situated vocabulary learning. *Research and Practice in Technology Enhanced Learning*, *11*(1), 4. https://doi.org/10.1186/s41039-016-0028-2
[121] Perry, B. (2018). ARIS: A tool to promote language learning through AR gaming. *CALICO Journal*, *35*(3), 333–342. https://doi.org/10.1558/cj.36318
[122] Hadid, A., Mannion, P., & Khoshnevisan, B. (2019). Augmented reality to the rescue of language learners. *Florida Journal of Educational Research*, 57(2), 81-89.
[123]Karacan, C. G., & Akoğlu, K. (2021). Educational augmented reality technology for language learning and teaching: A comprehensive review. *Shanlax International Journal of Education*, *9*(2), 68–79. https://doi.org/10.34293/education.v9i2.3715
[124]Santos, M. E. C., Lübke, A. I. W., Taketomi, T., Yamamoto, G., Rodrigo, M. M. T., Sandor, C., & Kato, H. (2016). Augmented reality as multimedia: The case for situated vocabulary learning. *Research and Practice in Technology Enhanced Learning*, *11*(1), 4. https://doi.org/10.1186/s41039-016-0028-2
Shadiev, R., & Liang, Q. (2024). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching, 18*(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804
[125] Barreira, J., Bessa, M., Pereira, L. C., Adão, T., Peres, E., & Magalhães, L. (2012, June). MOW: Augmented reality game to learn words in different languages: Case study: Learning English names of animals in elementary school. In *7th Iberian Conference on Information Systems and Technologies (CISTI 2012)* (pp. 1–6). IEEE. https://doi.org/10.1109/CISTI.2012.6221606

children who received audiovisual cues to guide their pronunciation and writing skills (see Figure 17). As they conclude, 'the use of AR games has a positive pedagogical impact in the learning process concerning young children, more exactly in the progressive domain of oral recognition of words and concepts and their corresponding written form' (p.5).

Figure 17. *Children using MOW*[126]

2.5.2 Pronunciation

Pronunciation encompasses the distinctive speech sounds (phonemes) of specific languages, the ways in which these combine (phonotactics), the placement of emphasis (stress), and the rising and falling patterns of longer units, such as phrases and sentences (intonation). AR applications can provide real-time feedback on a learner's pronunciation, highlighting areas for improvement and offering corrective guidance.

Instructed pronunciation learning involves creating perceptual and articulatory awareness and providing opportunities for the extended practice of perception and motor skills. It is also common to include training on how speech sounds are represented in writing. For languages with alphabetic writing systems, this process will typically involve phoneme-grapheme mapping. To date, however, only limited attention has been given to aspects of pronunciation in respect of AR.

On the phoneme level, AR can help raise articulatory awareness by drawing learners' attention to the shape of the mouth when producing particular sounds. Mirrors are a low-tech, effective tool that has long been used for this purpose. Using a dedicated app, Zhu et al. (2022)[127] demonstrated how using the mobile phone as a high-tech mirror could draw learners' attention to their lips and tongue while producing English phonemes. By focusing on the mouth rather

[126] Barreira, J., Bessa, M., Pereira, L. C., Adão, T., Peres, E., & Magalhães, L. (2012, June). MOW: Augmented reality game to learn words in different languages: Case study: Learning English names of animals in elementary school. In *7th Iberian Conference on Information Systems and Technologies (CISTI 2012)* (pp. 1–6). IEEE. https://doi.org/10.1109/CISTI.2012.6221606

[127] Zhu, J., Zhang, X., & Li, J. (2022). Using AR filters in L2 pronunciation training: Practice, perfection, and willingness to share. *Computer Assisted Language Learning*, 1–30. https://doi.org/10.1080/09588221.2022.2080716

than the face as a whole, learners may also feel less self-conscious, particularly if they are required to make an accompanying video recording (see Figure 18).

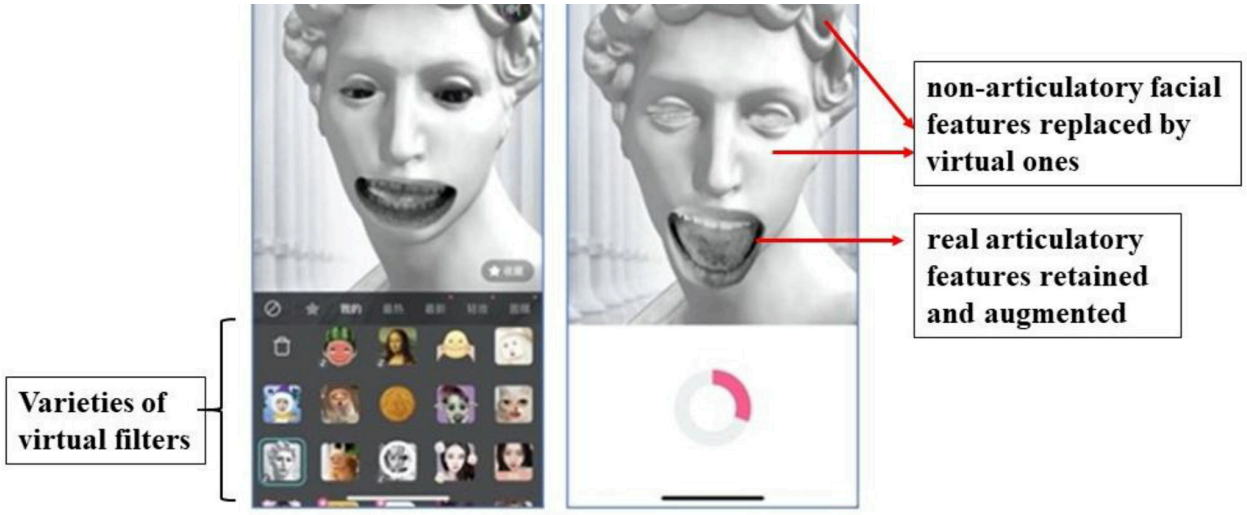


Figure 18. *Screenshot from the app used to support the production of English phonemes*[128]

A way forward here might be to deploy AI to design an active feedback system which could detect errors and demonstrate how learners might change lip or tongue position to better approximate the target sound. The learner's live image could be superimposed on top of a target mouth shape. Visual linguistic input is known to have a powerful influence on one's auditory processing. The McGurk effect,[129] for instance, shows that visual input in the form of lip movements can override the acoustic signal. While the processing of information from lip movements seems to come to speakers naturally, the results from experiments on tongue visualisation nevertheless suggest that one does not benefit as much from such information, at least not without training, and it is still not yet clear whether training has much effect.

In perceptual training, a focus on form-meaning mapping should be provided from the start, and the more senses that are involved the better. In the case of phonemes, one could use virtual objects to establish examples or 'anchor points', with a strong semantic basis for each sound.

On a more general level, AR can provide learners with variation by introducing other voices, accents and dialects into the language classroom.

2.5.3 Morphology

Morphology refers to the systems by which 'base-forms' of a language are manipulated to change their meaning. In English, for example, nouns are routinely pluralised by the addition of the sound or letter -s (or -es), and past tenses by -d (or -ed). Other languages may involve a wider range of options depending on the case or person, for example.

Although AR technology lends itself well to the development of morphology-focused applications and game-based experiences for instructional language learning, there is currently little research in this area. The ARETE project developed 3D phoneme glyphs to help with

[128] Zhu, J., Zhang, X., & Li, J. (2022). Using AR filters in L2 pronunciation training: Practice, perfection, and willingness to share. *Computer Assisted Language Learning*, 1–30. https://doi.org/10.1080/09588221.2022.2080716
[129] https://en.wikipedia.org/wiki/McGurk_effect

literacy development (ARETE, 2022),[130] as per Figure 19. The UNBODY art installation for spatial poetry included a word composer, engaging the audience in composing novel words out of prefix, stem, and suffix offered to then unveil a definition (Wild et al., 2021)[131]. However, modern imaging techniques such as photogrammetry could be used to develop 3D models by scanning real-world contexts in which learners could be guided to explore and interact with prefixes, suffixes, and other word formation patterns (Cieri et al., 2021). Existing AR-mediated language learning games, which typically focus on vocabulary building, could be transformed by incorporating the contextual morphological properties of the target language. These experiences could be made even richer by using AI technology to provide support and personalised feedback.

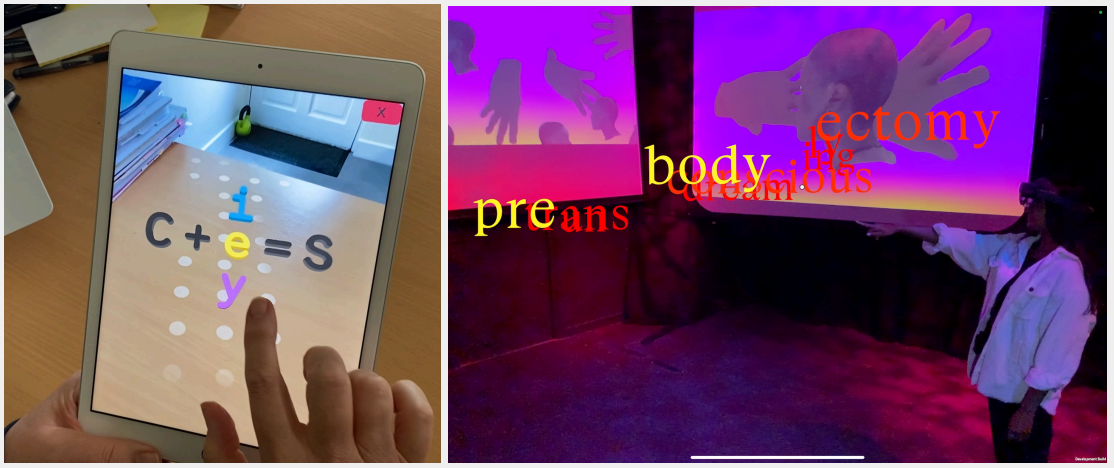


***Figure 19**. Words Worth Learning app of the ARETE project for English literacy development (ARETE, 2022,[132] left); UNBODY word composer (Wild et al., 2021,[133] right).*

2.5.4 Grammar

Grammar refers to the patterns of sentence construction in different languages and the ways in which their components are typically sequenced and manipulated (e.g. to form negatives or questions). These are commonly referred to in language instruction as 'rules'.

Studies exploring the use of AR-mediated grammar-focused tasks include Valle (2014),[134] who describes its deployment to teach the verbs 'ser' versus 'estar' and the subjunctive in Spanish - among other linguistic elements. In one of these activities, students effectively act as 'teachers' by creating a cartoon character who offers a thorough explanation on the use of 'ser' and 'estar'

[130]ARETE (2022): Interactive collaborative ARETE Mobile app for Pilot 1, Deliverable D3.3, ARETE consortium. https://zenodo.org/records/5060355
[131]Wild, F., Marshall, L., Bernard, J., White, E., & Twycross, J. (2021). UNBODY: A poetry escape room in augmented reality. *Information, 12*(8), Article e295. https://doi.org/10.3390/info12080295
[132]ARETE (2022): Interactive collaborative ARETE Mobile app for Pilot 1, Deliverable D3.3, ARETE consortium. https://zenodo.org/records/5060355
[133]Wild, F., Marshall, L., Bernard, J., White, E., & Twycross, J. (2021). UNBODY: A poetry escape room in augmented reality. *Information, 12*(8), Article e295. https://doi.org/10.3390/info12080295
[134] Valle, R. (2014). Teaching with augmented reality is here: EdTech Review: Insight. Online posting retrieved from: https://www.edtechreview.in/trends-insights/insights/teaching-with-augmented-reality-it-s-here/

in a recorded session, which is then delivered in class. Berns and Valero-Franco (2024, 2025)[135] explored the use of AR to teach German prepositions that learners need to describe places in their daily lives, such as the house or the classroom (see Figure 20).

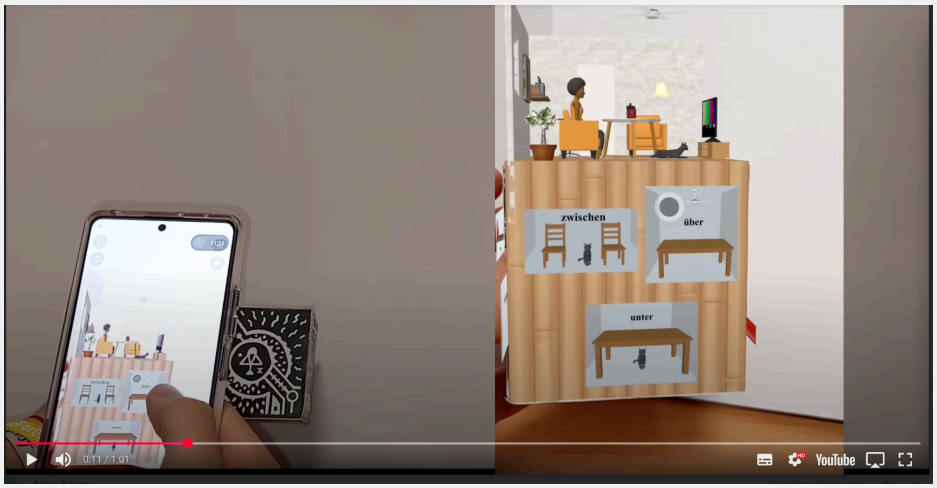


Figure 20. *Example for a vocabulary and grammar learning AR app (Objects and Prepositions)* *https://youtu.be/sWd3VnYjLQk?feature=shared*

Draxler et al. (2020)[136] describe an AR app that was designed to generate quizzes to enhance the learning of grammar and vocabulary. While learners enjoyed participating in these interactive instructional experiences, the authors did not find any evidence of enhanced grammar skills development, improved vocabulary retention, or use in real life contexts compared to the deployment of static images for the same purposes.

In another study, Weydan et al. (2022)[137] explore the potential of deploying AR technologies for enhancing learners' academic achievement in English, including grammar. Instead of focusing on English language learners, they shift attention to teachers and educators, who are invited to participate in interviews to share their views on the kind of skills that AR can help learners build, such as reading and vocabulary. According to their study, AR can guide learners in accomplishing 'specific goals that are considered the core of activities in instructional environments, such as the ability of the students to answer grammar, reading, listening, and reading tasks independently' (p. 10). The game-based nature of AR-mediated environments has yet to be explored to examine the role of structured AR-mediated game-like activities in enhancing students' declarative grammatical knowledge, retention, and active production of newly acquired grammatical structures. In traditional textbooks, grammar activities are often enacted to promote explicit grammar instruction but learners are rarely exposed to the actual use of these grammatical constructions in naturalist communication. AR-mediated applications

[135] Berns, A., & Valero-Franco, C. (2024). Embracing transition: The impact of emerging technologies on language learning pedagogies. *Proceedings of the International CALL Research Conference*, *2024*, 15–22. https://doi.org/10.29140/9780648184485-03
Berns, A., & Valero-Franco (2025). From users to creators: Harnessing Extended Reality and End-User Development tools in Language Education. In A. Alm, C. Lai, & A. Ma (Eds.), *Transitions in CALL*, Castledown Publisher. *Transitions in CALL*. Castledown Publishers. https://doi.org/10.29140/9781914291272 (forthcoming).
[136] Draxler, F., Labrie, A., Schmidt, A., & Chuang, L. L. (2020). Augmented reality to enable users in learning case grammar from their real-world interactions. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)* (Paper 410, pp. 1–12). ACM. https://doi.org/10.1145/3313831.3376312
[137] Wedyan, M., Falah, J., Elshaweesh, O., Alfalah, S. F., & Alazab, M. (2022). Augmented reality-based English language learning: Importance and state of the art. *Electronics, 11*(17), 2692. https://doi.org/10.3390/electronics11172692

can be developed to enact socially-situated environments where learners build and apply new grammatical knowledge in specific contexts. Feedback provision could also be considered in the development of these applications, as well as learners' level of linguistic proficiency and learning needs in order to adapt the activities to meet their learning needs.

2.5.5 Phraseology

In recent decades the use of corpus technology has greatly contributed to highlighting the prevalence of frequently occurring word combinations - also known as lexical chunks or formulaic sequences - in authentic human communication.[138] These may take the form of fixed units (e.g., little by little; as a matter of fact; global warming; all the best) or flexible frames with slots for a limited range of alternatives (e.g. Yours (-, truly, sincerely, faithfully); (I'm/you're) on (my/your) own; (he/they) (can't/couldn't) help it).

The fact that these 'ready-made' word sequences form the basis of up to 80% of everyday speech and writing across all languages poses a significant challenge to long-held beliefs about language being produced and understood from their minimal component parts (words). They are nevertheless thought to make language production and comprehension faster and less effortful, while enhancing group belonging through the use of shared idiomatic expressions. [139, 140]

Increasingly assumed to be the basis of first (child) language acquisition,[141, 142] these pragmatically appropriate integrated linguistic units offer the language learner a highly effective, motivating, competent-speaker sounding means of communicating from beginner level onwards, and, as such, should constitute a central component of contemporary language instruction.[143,144,145,146] They are nevertheless often neglected by educators and course books, whose tendency to focus on atomistic, building block approaches to language instruction can be demotivating if it is not based on actual language use.

In terms of AR, contextually appropriate lexical chunks could be introduced and practised through the use of meaningful authentic scenarios in which the learner selects from a range of appropriate utterances, perhaps modifying them where they offer flexibility. After copying an audio representation of the utterance, the learner could engage in dialogues with the Virtual Instructor - or possibly several interlocutors - in the form of a more sophisticated version of Mondly AR.

2.5.6 Pragmatics

Pragmatics refers to the multifaceted ways in which language is deployed to convey particular meanings in specific real-life spoken and written communicative contexts. While some scholars question whether foreign language learners can build pragmatic competence through formal

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[138] Sinclair, J. (1991) *Corpus, concordance, collocation,* Oxford, Oxford University Press.
[139] Pawley, A. & Syder, F. H. (1983) Two puzzles for linguistic theory: nativelike selection and nativelike fluency. In Richards, J. C. & Shmidt, R. W. (Eds.) *Language and communication.* New York, Longman.
[140] Wray, A. (2002) *Formulaic language and the lexicon,* Cambridge, Cambridge University Press.
[141] Peters, A. M. (1983) *Units of language acquisition,* Cambridge, Cambridge University Press.
[142] Tomasello, M. (2003) *Constructing a language: a usage-based theory of language acquisition,* Cambridge MA, Harvard University Press.
[143] Lewis, M. (1993) *The lexical approach,* Hove, Language Teaching Publications.
[144] Howarth, P. (1998). Phraseology and second language proficiency. *Applied Linguistics*, *19*(1), 24–44. https://doi.org/10.1093/applin/19.1.24
[145] Wray, A. (2000). Formulaic sequences in second language teaching: Principles and practice. *Applied Linguistics*, *21*(4), 463–489. https://doi.org/10.1093/applin/21.4.4639.
[146] Lindstromberg, S. & Boers, F. (2008) *Teaching chunks of language,* Innsbruck, Helbling Languages.

instruction alone [147,148] others (e.g. Kasper & Rose, 2001)[149] consider this possible. Opportunities to interact with members of the target culture and exposure to the socially-situated beliefs of those communities are nevertheless likely to enhance this process. How far AR-mediated activities can be deployed to teach pragmatic competence is as yet unclear. However, the fact that they can promote interaction and collaboration, and incorporate intercultural awareness and understanding holds promise.

Figure 21. *Mentira AR-mediated game*[150]

In their study on pragmatic comprehension development, Shakouri et al. (2022)[151] compared the 'different effects of the Non-Computer Mediated Instruction with Computer-Mediated Instruction, Multi User Virtual Environments, and Mobile Augmented Reality Games (MARGs) on Iranian EFL learners' comprehension of English speech-acts', concluding that virtual environments can be more effective in building pragmatic comprehension in the target language than MARGs. Holden and Sykes (2011),[152] in turn, designed game-driven activities that invited students to interact with non-playing characters (NPCs) and explore the consequences of framing requests intended to solicit information from the characters to solve a mystery. The AR-mediated game Mentira (see Figure 21) brings the topic of pragmatics to the forefront, and the game's conversations about social niceties naturally lead to discussions about pragmatics, both in educational settings and student interactions.[153] However, studies on the role of

[147] Kondo, S. (2008) *Effect on pragmatic development through awareness-raising instruction: Refusals by Japanese EFL learners.* In E. A. Soler & Martinez-Flor, A. (Eds.), Investigating pragmatics in foreign language learning, teaching and testing (pp. 153-177). Bristol: Multilingual Matters.
[148] Nikula, T. (2008) Learning pragmatics in content-based classrooms. In E. A. Soler & Martinez-Flor, A. (Eds.), *Investigating pragmatics in foreign language learning, teaching and testing* (pp. 94-113). Bristol: Multilingual Matters.
[149] Kasper, G., & Rose, K. (2001) Pragmatics in language teaching. In K. Rose & G. Kasper (Eds.), *Pragmatics in Language Teaching* (Cambridge Applied Linguistics, pp. 1-10). Cambridge: Cambridge University Press.
[150] https://localgameslababg.wordpress.com/projects/mentira/
[151] Shakouri, A., Malmir, A., & Esfandiari, R. (2022). Cultivating L2 pragmatic comprehension through computerized vs. non-computerized instruction, Multiuser Virtual Environments (MUVEs) and Mobile Augmented Reality Games (MARGs). *Issues in Language Teaching*, *11*(1), 313-358.
[152] Holden, C. L., & Sykes, J. M. (2011). Leveraging mobile games for place-based language learning. *International Journal of Game-Based Learning*, *1*(2), 1–18. https://doi.org/10.4018/ijgbl.2011040101.
[153]Holden, C. L., & Sykes, J. M. (2012). Mentira: Prototyping language-based locative gameplay. In *Mobile media learning: Amazing uses of mobile devices for learning* (pp. 111–130). Routledge.

specifically designed AR or game-based activities in promoting the development of pragmatic comprehension, awareness, and competence remain scarce. Further, studies need to move beyond speech acts to investigate the development of proxemics (the personal space people require to feel comfortable when interacting with others), gestures, and intercultural pragmatics.

2.6 Communicative modes

The different linguistic elements identified above are complemented by the various communicative modes involved in real-life communication. Teachers and course books have traditionally tended to focus on what frequently are referred to as the 'four skills': namely listening, speaking, reading and writing. However, we feel that the terms 'communicative modes' (or 'competencies') more accurately describe these complex activities - which involve the deciphering or production of a flow of multiple linguistic elements at one time.

Such competencies are often taught in isolation. However, in everyday life users move between several modes, whether alone or in interaction with others. A simple example might involve listening to a news report on the radio, noting down an item of particular relevance, and communicating this information to a friend - be this orally by phone or in writing by text message. It is important to reflect this reality in instructional design, along with the fact that learners' abilities will necessarily vary across different modes and the linguistic elements deployed within them. Although this is possible using conventional instructional methods, AR offers scope for heightening the veracity of the communicative contexts involved and personalising the associated content to individual learners' needs.

A helpful reference point in designing such activities in the context of language curricula and learning-teaching objectives in Europe is the Common European Framework of Reference for Languages (CEFR)[154] Recently the CEFR was extended to incorporate a number of additional elements, including the practice of 'mediation'.[155] It has also been made more modality-inclusive, such that 'word/sign' is used in the descriptors instead of simply 'word', for instance.

The following subsections explore the possibilities for developing these different modes through the use of AR.

2.6.1 Listening and speaking

Despite the potential of AR technologies in promoting listening and speaking in another language, few studies explore this area. In an early study, Liu (2009)[156] examined HELLO, a learning environment designed to improve high school students' English listening and speaking skills. HELLO utilised game-based learning with AR and ubiquitous technologies. Students

[154] Available since 2001 and applicable to all languages, the framework encompasses a set of descriptors - in the form of progressive 'can do statements' - at six levels (A1, A2, B1, B2, C1, C2) for each of five competencies: listening, speaking - which is usefully divided into spoken production (not something often done in isolation in real life) and spoken interaction (more common and necessarily more complex as it also involves listening), reading and writing *https://www.coe.int/en/web/common-european-framework-reference%20languages/level-descriptions*

[155] Mediation occurs when the user/learner acts as a social agent who creates bridges and helps to construct or convey meaning, sometimes within the same language, … and sometimes from one language to another (cross-linguistic mediation)" (Council of Europe, 2020, p. 90). Council of Europe. (2020). Common European framework of reference for languages: Learning, teaching, assessment. Companion volume with new descriptors.

[156] Liu, T. Y. (2009). A context-aware ubiquitous learning environment for language listening and speaking. *Journal of Computer Assisted Learning, 25*(6), 515–527. https://doi.org/10.1111/j.1365-2729.2009.00326.x

participated in various activities, including a collaborative story relay that required them to record themselves speaking English. This demonstrated that AR and ubiquitous technologies can be effective in creating context-aware, immersive experiences that promote listening and speaking.

AR game-based activities have the potential to promote collaboration among learners and facilitate the development of speaking skills. Another study focusing on the use of AR to help language learners develop their listening and speaking skills was conducted by Valero-Franco and Berns (2024).[157] For their study, the authors developed a game-based activity called 'Who am I?'. This activity requires learners to work in pairs, taking turns to describe and guess different characters hidden behind QR codes (see Figure 22).

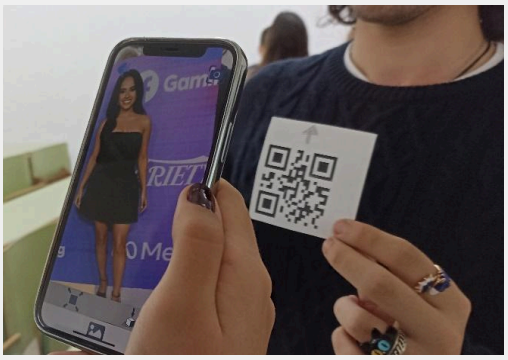

Figure 22. *Example from the AR activity Who am I?*

However, in addition to marker-based, location-based or projection-based AR, a combination of AR and AI could be deployed to explore further the potential of these technologies in promoting listening in different language learning contexts involving a range of linguistic elements.

2.6.2 Reading

AR activities such as reading games can be useful to young language learners in the foreign language classroom. For instance, Tobar-Muñoz et al. (2017) designed a game in the form of an Augmented Book, adapted from a real storybook, which features distinct scenes and challenges on every page for the player to engage with. The results indicate that although there is no disparity in reading comprehension outcomes between the game and conventional methods, children do exhibit higher enthusiasm and curiosity toward the activity. Moreover, the activity gains added value as it encourages problem-solving, exploration, and social interaction behaviours.[158]

2.6.3 Writing

The design and deployment of AR applications to enhance instructed language learners' writing skills, including sentence construction and orthography, has been the focus of a number of

[157] Valero-Franco, C., & Berns, A. (2024). *Development of virtual and augmented reality apps for language teaching: A case study*.[Desarrollo de apps de realidad virtual y aumentada para enseñanza de idiomas: Un estudio de caso].*RIED-Revista Iberoamericana de Educación a Distancia*, 27(1), 163-185. https://doi.org/10.5944/ried.27.1.376
[158] Tobar-Muñoz, H., Baldiris, S., & Fabregat, R. (2017). Augmented reality game-based learning: Enriching students' experience during reading comprehension activities. *Journal of Educational Computing Research*, *55*(7), 901–936. https://doi.org/10.1177/0735633116689789

studies. Wang (2017),[159] for example, discusses the development and implementation of an AR-mediated writing system among Taiwanese learners of Chinese and compares the findings to a control group that relied on traditional writing material. The intermediate-level students benefited the most from the AR techniques regarding their writing performance in terms of content control, structure, and phrasing (p.162).

Lin et al. (2020),[160] on the other hand, examine how a recently created ubiquitous application might improve participants' writing development in English as a foreign language by enhancing long-term memory, motivation, and self-regulated cognition. The authors compared the results of a group of EFL learners who used the AR-mediated application for their writing (ARCAUW) and the control group who used the mobile-mediated in-class writing mode. As they demonstrate 'although both modes led to significant improvement in writing the process analysis essay, ARCAUW was conducive to the development of task schema in long-term memory, motivation, and self-regulation in writing' (p. 989). However they found that further cognitive processing, emerging during the use of AR-mediated activities, generated mixed outcomes.

Liu and Tsai (2013)[161] also examine the role of AR-mediated materials in assisting learners in building new knowledge about buildings, areas and views and the role of this newly acquired knowledge in their writing in the target language, English. The authors describe the students' engagement in the learning scenario as high, involving the building of language and content knowledge and resulting in insightful essays (see Figure 23). When the learner utilises their mobile phone to point in a particular direction, the device rapidly identifies their location, and the built-in camera automatically captures peripheral images. Simultaneously, the AR-based mobile learning material generates relevant information, such as names and descriptions of nearby buildings. The captured images and generated information are then displayed on the mobile phone screen. If the learner wishes to delve deeper into details about a specific building or scenic spot, they can click on specific information displayed on the screen, leading to the presentation of more comprehensive information.

[159] Wang, Y. H. (2017). Exploring the effectiveness of integrating augmented reality-based materials to support writing activities. *Computers and Education*, *113*, 162–176. https://doi.org/10.1016/j.compedu.2017.04.013
[160] Lin, V., Liu, G., & Chen, N. (2020). The effects of an augmented-reality ubiquitous writing application: A comparative pilot project for enhancing EFL writing. *Computer Assisted Language Learning, 33*(1), 1–42. https://doi.org/10.1080/09588221.2019.1706085
[161] Liu, P. E., & Tsai, M. (2013). Using augmented-reality-based mobile learning material in EFL English composition: An exploratory case study. *British Journal of Educational Technology, 44*(1), E1–E4. https://doi.org/10.1111/j.1467-8535.2012.01315.x

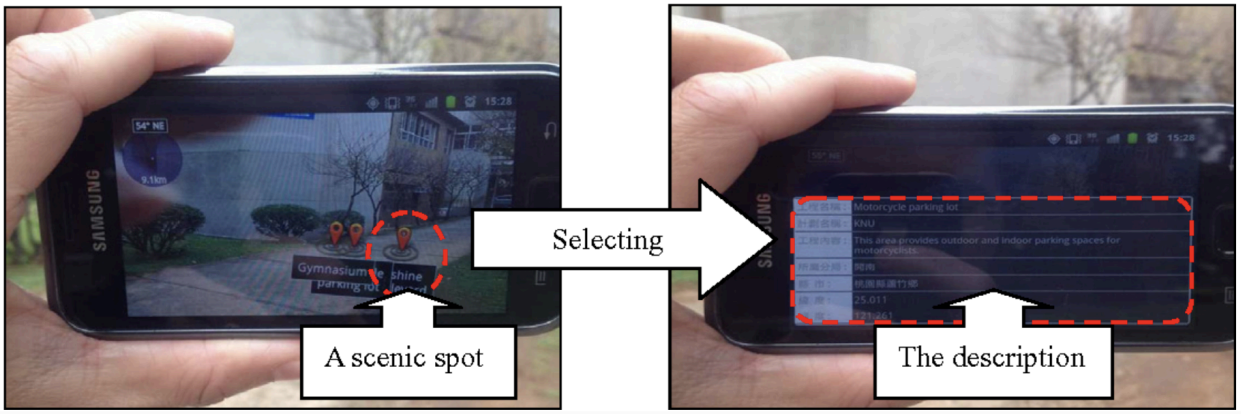

Figure 23. *A demo of how an EFL learner engages with AR mobile learning content on campus.*

Despite claims that AR-mediated tasks can support 'long-term memory, motivation, and self-regulation of cognitive processes in writing' [162p. 30] its role in developing and enhancing writing skills remains unclear and requires further examination.

[162] Lin, V., Liu, G., & Chen, N. (2020) The effects of an augmented-reality ubiquitous writing application: a comparative pilot project for enhancing EFL writing. *Computer Assisted Language Learning,* 1-42.

Why include AR in your language learning materials?

1. AR allows for multimodal learning because it is possible to display videos, images, and 3D objects, and play an audio file. Regarding learning, cognitive theory of multimedia learning suggests that people learn better when words and pictures are used together rather than just words alone.

2. AR supports the development of various skills related to language learning such as reading, writing, listening, speaking, interpersonal and cultural understanding.

3. AR allows to create contextual and immersive learning by for example using GPS-features and taking learning out of the classroom, which allows to improve learners satisfaction and motivates them[163].

4. AR is especially useful in the classroom when incorporating real-world objects that are otherwise not available in the classroom; AR makes objects and things more tangible and visible. Seeing objects in 3D rather than on a flat computer screen or on a sheet of paper can engage students more in an activity. Consequently, students' motivation can increase.

5. AR helps learners to prepare for using a language in real life by creating situations that force the use of a language in an unplanned or spontaneous way. Unlike in a classroom where students might feel anxiety, it is easier for learners to stay in their comfort zone.

6. Compared to other technologies, AR is relatively accessible because learners only need a smart mobile device and an AR application.

[163] Solak, E., & Cakir, R. (2015). Exploring the effect of materials designed with augmented reality on language learners' vocabulary learning. *Journal of Educators Online*, *12*(2), 50–72. https://doi.org/10.9743/JEO.2015.2.5

Section 3: Setting the scene for teaching with Augmented Reality

3.1 How AR fits to learning design in general

The future of AR in education looks encouraging and promising.[164,165] Educators globally seek to identify new innovative and attractive ways to engage their learners.[166] In fact, as previously shown (see Section 2.2) the use of AR in educational contexts can revolutionise learning and improve learning performance. AR can be an ideal environment where learners can better understand the real world by introducing multimedia as activators of prior knowledge, motivators and facilitators to learning. Therefore, AR is a key for introducing contextualised learning environments where learners are having real world-like experiences.[167, 168, 169]

AR in language learning, is underpinned by a variety of pedagogical theories and approaches that leverage its unique capabilities to create engaging and effective learning experiences. These theories often focus on active, contextual, and interactive learning. Key pedagogical theories and approaches supporting the use of AR include the Cognitive Theory of Multimedia Learning (CTML) from Mayer[170], informs the design of AR applications by emphasising the effective presentation of information through multiple sensory modalities (visual, auditory). AR applications, which present texts, graphics, sounds, videos, and 3D models simultaneously and contextually, are well-suited to CTML principles like spatial and temporal contiguity, helping to reduce cognitive load and simplify abstract concepts into concrete forms.[171]

Situated Learning Theory is also behind the use of AR. This theory posits that learning is most effective when it occurs in authentic contexts and real-world environments, where knowledge is socially constructed.[172] AR facilitates this by superimposing digital information onto the physical world, creating immersive and realistic scenarios (e.g., a virtual supermarket).[173] This allows

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[164] Karamanoli, P., & Tsinakos, A. (2015, September). Use of Augmented Reality in terms of creativity in School learning. In Workshop of making as a pathway to foster joyful engagement and creativity in learning (Make2Learn) (Vol. 45).

[165] Garzón, J. (2021). An overview of twenty-five years of augmented reality in education. *Multimodal Technologies and Interaction*, *5*(7), 37. https://doi.org/10.3390/mti5070037

[166] Mystakidis, S., Christopoulos, A., & Pellas, N. (2022). A systematic mapping review of augmented reality applications to support STEM learning in higher education. *Education and Information Technologies*, *27*(3), 1883–1927. https://doi.org/10.1007/s10639-021-10682-1

[167] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c

[168] Parmaxi, A., & Demetriou, A. A. (2020). Augmented reality in language learning: A state-of-the-art review of 2014–2019. *Journal of Computer Assisted Learning*, *36*(6), 861–875. https://doi.org/10.1111/jcal.12486

[169] Panagiotidis, P. (2021). Augmented and mixed reality in language learning. *European Journal of Education, 4*(2), 28-44. https://doi.org/10.26417/501ibq23c

[170] Mayer, R. (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press.
Mayer, R. (2017). Using multimedia for e-learning. *Journal of Computer Assisted Learning*, 33(5), 403–423. https://doi.org/10.1111/jcal.12197

[171] Demirdag, M. C., Kucuk, S., & Tasgin, A. (2024). An investigation of the effectiveness of augmented reality technology supported English language learning activities on preschool children. *International Journal of Human–Computer Interaction*, *41*(2), 1–14. https://doi.org/10.1080/10447318.2024.2323278

[172] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804

[173] Perry, B. (2021). Gamified mobile collaborative location-based language learning. *Frontiers in Education*, *6*, 689599. https://doi.org/10.3389/feduc.2021.689599

learners to apply concepts in real-world scenarios, fostering a deeper understanding and practical language use.

Aligned with situated learning, constructivism, social constructivism and sociocultural theory emphasise that learners actively construct their own knowledge through exploration and interaction with their environment and their peers.[174]AR-supported activities encourage peer-to-peer learning, group cooperation, and environments where students can explore digital and physical elements, promoting active cognitive knowledge construction.[175]

Many AR applications incorporate elements of gamification or Game-Based Learning (GBL), and some are designed as games, which are highly effective in increasing student enjoyment.[176],[177]Examples include AR quests and mystery games that compel participants to engage with specific locations and problem-solving activities.[178]

Dual Coding Theory suggests that information is better processed and retained when presented both verbally and nonverbally (e.g., imagery).[179] AR, by its nature, overlays virtual images, texts, and sounds onto the real world, naturally supporting dual coding and enhancing comprehension and memory retention.

Particularly relevant for second language (L2) pronunciation training, the Skill Acquisition Theory emphasises the transition from declarative knowledge ("knowing that") to procedural knowledge ("knowing how") through deliberate practice and feedback.[180] AR filters, for example, can provide real-time visual feedback on articulatory gestures, aiding learners in developing procedural knowledge and reducing anxiety related to corrective feedback.[181]

Experiential Learning Theory asserts that meaningful learning occurs when learners apply concepts through direct experience in real-world scenarios. AR enables learners to combine physical experience with their imagination, making learning more impactful.[182]

Cognitive Load Theory aims to optimize instructional design to prevent cognitive overload, especially in multimedia-rich environments. Well-designed AR applications can reduce cognitive

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[174]Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804

[175] Cai, Y., Pan, Z., & Liu, M. (2022). Augmented reality technology in language learning: A meta-analysis. *Journal of Computer Assisted Learning*, 38(4), 929-945. https://doi.org/10.1111/jcal.12661

[176] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.222980 4

[177] Berns, A., & Parmaxi, A. (2025). Game-based LLT environments. In L. McCallum & D. Tafazoli (Eds.), *The Palgrave Encyclopedia of Computer-Assisted Language Learning* (pp. 1–10). Palgrave Macmillan. https://doi.org/10.1007/978-3-031-51447-0_123-1

[178] Kaplan-Rakowski, R., & Papin, K. (2024). Augmented Reality-Assisted Language Learning (ARALL). *SSRN*. https://doi.org/10.2139/ssrn.4894258

[179] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804

[180]Zhu, J., Zhang, X., & Li, J. (2022). Using AR filters in L2 pronunciation training: Practice, perfection, and willingness to share. *Computer Assisted Language Learning*, *37*(5–6), 1364–1396. https://doi.org/10.1080/09588221.2022.2080716

[181]Zhu, J., Zhang, X., & Li, J. (2022). Using AR filters in L2 pronunciation training: Practice, perfection, and willingness to share. *Computer Assisted Language Learning*, *37*(5–6), 1364–1396. https://doi.org/10.1080/09588221.2022.2080716

[182] Khodabandeh, F. (2023). Exploring the viability of augmented reality game-enhanced education in WhatsApp flipped and blended classes versus the face-to-face classes. *Education and Information Technologies*, 28(1), 617-646.

load by presenting information effectively and concretely, for example, by visualizing abstract vocabulary or providing contextual information[183].

ARCS Model (Attention, Relevance, Confidence, Satisfaction) (Keller, 1987[184]) explains learning through the lens of motivation, arguing that learners are more likely to acquire and retain knowledge when four conditions are met: Attention (their curiosity is engaged), Relevance (content connects to personal goals and needs), Confidence (they believe they can succeed), and Satisfaction (they feel rewarded by achievement). In language learning, ARCS supports the idea that motivation is not separate from cognition but integral to learning itself, since meaningful, confidence-building, and rewarding communicative tasks foster deeper engagement and more effective language acquisition.[185] AR applications consistently show positive impacts on student motivation, engagement, and satisfaction due to their novelty, interactivity, and ability to provide a sense of accomplishment.[186]

AR is also closely linked to Flow Theory since its immersive and engaging nature can lead to a state of complete absorption and enjoyment (flow), which is beneficial for learning.[187] Figure 24 demonstrates the alignment of AR with several pedagogical theories of learning.

Stemming from the aforementioned pedagogical theories, the following key pedagogical strategies and approaches are employed in AR and language learning. For example Game-Based Learning (GBL) and Task-Based Learning[188] an approach that includes collaborative quest-based games, where learners interact with characters to receive clues or advance storylines, fostering both written and oral language skills.[189] The "Rewilding" Pedagogy is an innovative concept which focuses on designing "structured unpredictability" in language tasks to encourage goal-directed interaction outside traditional classrooms.[190]This approach allows learners to develop their own strategies for achieving objectives in dynamic, real-world environments, integrating formal learning with authentic linguistic engagement.

[183] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804
[184] Keller, J.M. Development and use of the ARCS model of instructional design. *Journal of Instructional Development* 10, 2–10 (1987). https://doi.org/10.1007/BF02905780
[185] Liao, C. H. D., Wu, W. C. V., Gunawan, V., & Chang, T. C. (2024). Using an augmented-reality game-based application to enhance language learning and motivation of elementary school EFL students: A comparative study in rural and urban areas. *The Asia-Pacific Education Researcher*, *33*(2), 307–319. https://doi.org/10.1007/s40299-023-00729-x
[186] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804
[187] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804
[188] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804
[189] Kaplan-Rakowski, R., & Papin, K. (2024). Augmented Reality-Assisted Language Learning (ARALL). *SSRN*. https://doi.org/10.2139/ssrn.4894258
[190] Thorne, S. L., Hellermann, J., & Jakonen, T. (2021). Rewilding language education: Emergent assemblages and entangled actions. *The Modern Language Journal*, *105*(S1), 106–125. https://doi.org/10.1111/modl.12687

Figure 24. *Pedagogical theories aligned with AR (own figure created with Napkin.ai).*

AR also integrates well with Problem-Based Learning (PBL) by creating immersive and authentic scenarios that require learners to solve challenges using their language skills. One such example is the mobile AR game Mentira, designed for second language (L2) Spanish learners. In this game, the central problem for learners is to solve a prohibition-era murder mystery set in a Spanish-speaking neighbourhood in Albuquerque, New Mexico.[191, 192] AR plays a crucial role by using mobile devices to trigger and interact with clues placed in the real-world environment. The design of Mentira incorporates PBL principles by giving each player different roles, clues, and parts of the story, which necessitates collaboration among players and even with local residents to complete the task. This approach situates the problem-solving within a realistic context, thereby enhancing engagement and providing a meaningful scenario for

[191]Holden, C. L., & Sykes, J. M. (2011). Leveraging mobile games for place-based language learning. *International Journal of Game-Based Learning*, *1*(2), 1–18. https://doi.org/10.4018/ijgbl.2011040101

[192] Thorne, S. L., Hellermann, J., & Jakonen, T. (2021). Rewilding language education: Emergent assemblages and entangled actions. *The Modern Language Journal*, *105*(S1), 106–125. https://doi.org/10.1111/modl.12687

language application. Evaluations of the game have indicated that it boosts student satisfaction with environmental interaction and increases their enthusiasm for learning. Other examples of pedagogical methods/approaches used include game-based learning, self-directed learning, context-aware learning, immersive learning, phonics-based approach, and Jolly phonics approach.[193]

3.2 Learning experience design principles and considerations

Instructors planning to implement AR y in their teaching practice would need to first take into account various pedagogical and technological considerations, including:

a. General instructional design principles: The design, development and deployment of AR requires a solid understanding of the affordances and limitations of AR applications which need to be driven by pedagogical principles, specific tasks and activities, goals and objectives, and be geared towards the needs of specific target groups. The specifications of the hardware and software to be used, connectivity, nature of the AR, context, content, nature of the activities, and multiple other variables need to be considered. AR implementation is neither simple nor based on a one-shot implementation, but rather requires extensive planning, collaboration with software developers, instructional designers, institutional and technical support in order to be launched successfully. In addition, as Dunleavy (2013)[194] advocates, when designing AR-mediated experiences, the following three principles need to be considered: '1. Enable and then challenge (challenge); 2. Drive by gamified story (fantasy); and 3. See the unforeseen (curiosity)' (p. 28). Most importantly, AR implementation needs to be guided by a collaborative approach where an experienced interdisciplinary team can exchange practices and perspectives, explore the pedagogical implications and learning needs of the students, develop activities that serve these needs, and be prepared to address the emerging challenges and contradictions. Alzahrani (2020)[195] "the general recommendation is to provide the support necessary for students to use the technological devices in AR and the skills necessary during the AR learning process" (p. 16). Similarly, both teacher and student training in AR and its pedagogical value is imperative in ensuring the effective implementation of AR-mediated activities in specific situated contexts and to enrich students' learning experiences.

b. Task-based and problem-based driven activities: The contradictions emerging from the deployment of AR applications for learning in various contexts warrant the need for customised task-based and/or problem-based learning activities. Multiple studies have reported that AR can generate cognitive overload and impose several challenges that might impede the learning process. [196, 197] For example, students may find it difficult to

[193] Shadiev, R., & Liang, Q. (2023). A review of research on AR-supported language learning. *Innovation in Language Learning and Teaching*, 18(1), 78–100. https://doi.org/10.1080/17501229.2023.2229804
[194]Dunleavy, M. (2014). Design principles for augmented reality learning. *TechTrends, 58*(1), 28–34. https://doi.org/10.1007/s11528-013-0717-2
[195] Alzahrani, N. M. (2020). Augmented reality: A systematic review of its benefits and challenges in e-learning contexts. *Applied Sciences, 10*(16), 5660. https://doi.org/10.3390/app10165660
[196]Dunleavy, M., Dede, C., & Mitchell, R. (2009). Affordances and limitations of immersive participatory augmented reality simulations for teaching and learning. *Journal of science Education and Technology*, *18*(1), 7–22. https://doi.org/10.1007/s10956-008-9119-1
[197] Alzahrani, N. M. (2020). Augmented reality: A systematic review of its benefits and challenges in e-learning contexts. *Applied Sciences, 10*(16), 5660. https://doi.org/10.3390/app10165660

learn when they are exposed to complex content and asked to navigate it, perform complex tasks whilst collaborating with peers and manipulating technology. “This is particularly true when students are expected to set up the devices on their own and multitask to accomplish learning targets” ([198]p.16). Consequently, AR-mediated activities should be enacted on certain manageable tasks-driven activities, while critical variables such as the device, virtual content, and nature of the task need to be considered very carefully. At the same time, these AR-mediated experiences need to be initially guided by experienced faculty members and/or instructional designers to immerse students in this process.

c. Target groups: The age, proficiency level, linguistic background, and field of study are some of the areas that would need to be considered in designing the AR-mediated activities. The activities need to be aligned with students’ learning needs, the curricula, and intended outcomes. At the same time, students need to be trained and initially guided in developing and deploying these technologies to perform certain tasks.

d. Curricula integration: Integration of AR activities into the curricula requires extensive planning, coordination, and alignment with the course content, learning goals and objectives, and intended outcomes. Alzahrani (2020)[199] notes that 'the learning activities that often characterise AR learning include studio-based pedagogy and participatory simulations' (p. 17). These approaches often make teachers leave their comfort zone and require innovation, compromisation, and adaptation to generate the intended outcome. Imperative to this process are teacher training, institutional and technical support to ensure the effective implementation of AR-mediated learning into the curricula.

3.3 Ensuring that AR fits your teaching goals and enhances your Teaching

To make the most of our teaching and to integrate AR and the technologies available effectively in our teaching syllabus it is important to reflect first on the following questions:

a) What is your teaching goal?
b) What is the pedagogical approach that best fits with your teaching goal?
c) What kind of activities and learning tools could help your students to learn the targeted content? and
d) What kind of technologies could fit with your goal and pedagogical approach. [200]

To start with this reflection and to help you design effective learning activities with AR and other technologies we suggest working always with a template as the one suggested by Harris et al. (2009).[201] As shown in Table 2, technology should be selected according to the learning goal and skills to be trained as well as the pedagogical approach and activity type selected.

[198] Alzahrani, N. M. (2020). Augmented reality: A systematic review of its benefits and challenges in e-learning contexts. *Applied Sciences, 10*(16), 5660. https://doi.org/10.3390/app10165660
[199] Alzahrani, N. M. (2020). Augmented reality: A systematic review of its benefits and challenges in e-learning contexts. *Applied Sciences*, *10*(16), 5660. https://doi.org/10.3390/app10165660
[200] Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action. *Journal of Research on Technology in Education*, *43*(3), 211–229. https://doi.org/10.1080/15391523.2011.10782570
[201] Harris, J., Mishra, P., & Koehler, M. (2009). Teachers’ technological pedagogical content knowledge and learning activity types. *Journal of Research on Technology in Education*, *41*(4), 393–416. https://doi.org/10.1080/15391523.2009.10782536

Table 2. *Aspects to consider before choosing the right technology to support the teaching/learning process.*

Learning goal/skills to be trained	Pedagogical approach	Activity type and brief description	Possible technologies
Listening & reading comprehension	-learning by doing -task-based learning -explorative learning	Field trip (Learners are invited to explore different places of a city gathering information on its monuments, culture, traditions, etc.)	AR and VR, social technologies, etc.
Vocabulary learning	-situated & contextualised learning	Associating the meaning of words and objects	AR & VR flashcards, H5P flashcards, etc.
Listening & vocabulary learning	-contextualised learning	Listening and answering questions on a concrete topic	Podcasts, videos
Speaking and discussion	-task-based learning	Small dialogues with peers (by means of synchronous/ Asynchronous interaction)	VR , Virtual Worlds, Zoom, Google Meet,
Reading & writing	-task-based learning	Writing short texts with peers on a concrete topic	Wikis, Google Documents

3.4 Examples of where and how to implement AR

In language learning, AR holds promise in a range of contexts, both proven and potential. Traditional language classrooms can be transformed into dynamic learning environments through the integration of AR whilst a tour to a place of interest such as a museum can be enhanced by augmented information in the target language. Applications on smartphones and tablets leverage AR to offer contextually rich experiences. Students can explore a foreign city while an AR app identifies and labels objects in the target language, enhancing vocabulary acquisition. AR also has potential regarding cultural exploration; visiting a museum becomes a linguistic journey when AR technology provides explanations and stories about artifacts directly in the language being learned. A summary of applications of AR for language learning follows:

Grasping concepts using printed material is probably the easiest and most frequently used application of AR. It consists of adding extra digital content to a conventional text-book or printed learning resource to make content more dynamic, visual and interactive. Such digital content may consist of virtual objects, images, audios or videos. In this sense, content and concepts that can be sometimes difficult to grasp, when explained verbally, can be more easily understood when illustrated and explained through visual and dynamic resources.[202] As illustrated in the above-mentioned examples, resources that could benefit from such augmentation are books, newspapers, postcards, works of art, amongst others. Augmentation can be reached by either linking/adding content from different online sources such as youtube, TikTok, webpages of museums or by adding selfmade and student-tailored contents such as

[202] Lytridis, C., Tsinakos, A., & Kazanidis, I. (2018). ARTutor—An augmented reality platform for interactive distance learning. *Education Sciences*, *8*(1), 6. https://doi.org/10.3390/educsci8010006

videos, audios, texts made by the teacher to address specific course contents and teaching needs. Students who could especially benefit from such AR resources are those who are primarily visual learners.

Placing virtual objects on a real surface is a type of markerless AR that places virtual 3D objects in the users' physical environment without any need of object tracking. This is made possible due to advancements in cameras, sensors, processors, and algorithms, which allow it to accurately detect and map the real-world. In the area of language learning this kind of application of AR could allow students to view and interact with virtual objects like animals, people, furniture, amongst others, that are often not at hand in the conventional learning environment but key to language learning.

In the following paragraphs, we will offer several examples and ideas to implement AR activities. All examples have been extracted from previous studies. [203, 204, 205]

A first very popular type of activities that could be enriched with AR are field trips and sightseeing tours. Such AR experiences could take place in the off-school or off-campus physical location. Exploration activities, enhanced tourist guides and places of interest nearby or on a map could enrich the learning experience. In this sense, student educational trips to historic places can use AR applications to experience important landmarks and view valuable information. Such activities can be implemented either through marker-based AR in order to display content on an interactive map, markerless AR to place a 3D model of an important landmark on a surface or location-based AR triggering activities by students' location.

Another type of activities that can be enriched by AR are treasure hunts or escape classroom games:

Treasure hunt is a type of game activity based on finding different clues and completing related tasks (e.g., answering questions, completing missing information in a text). This kind of activity can either be developed by using marker-based AR (Figure 25) or location-based AR. Using location-based AR could allow to implement such an activity even outdoors, inviting learners to seek for clues in an open environment (Figure 26).

[203] Terzopoulos, G., & Tsinakos, A. (2020). IPEAR. O1.1 A review of Augmented Reality Tools for Building Educational Experiences (unpublished)

[204] Terzopoulos, G., Kazanidis, I., Satratzemi, M., & Tsinakos, A. (2021). A comparative study of augmented reality platforms for building educational mobile applications. In *Internet of things, infrastructures and mobile applications*. *Proceedings of the 13th IMCL Conference 13* (pp. 307–316). Springer International Publishing. https://doi.org/10.1007/978-3-030-49932-7_30

[205] Atiker, B. (2023). Augmented reality games. In I. Management Association (Ed.), *Research Anthology on Game Design, Development, Usage, and Social Impact* (pp. 121-143). IGI Global. https://doi.org/10.4018/978-1-6684-7589-8.ch007.

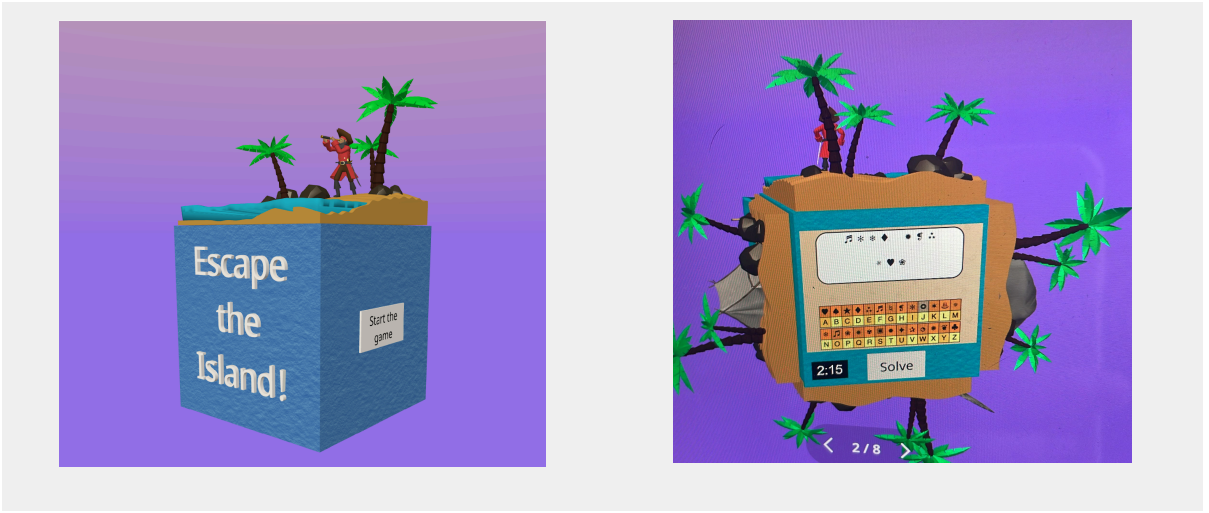

Figure 25. *Example of a treasure hunt activity based on marker-based AR (link to access a videoclip of the activity (https://youtu.be/MUV8ugio_Mk?si=wNmvlwu8pJrMNIni)*

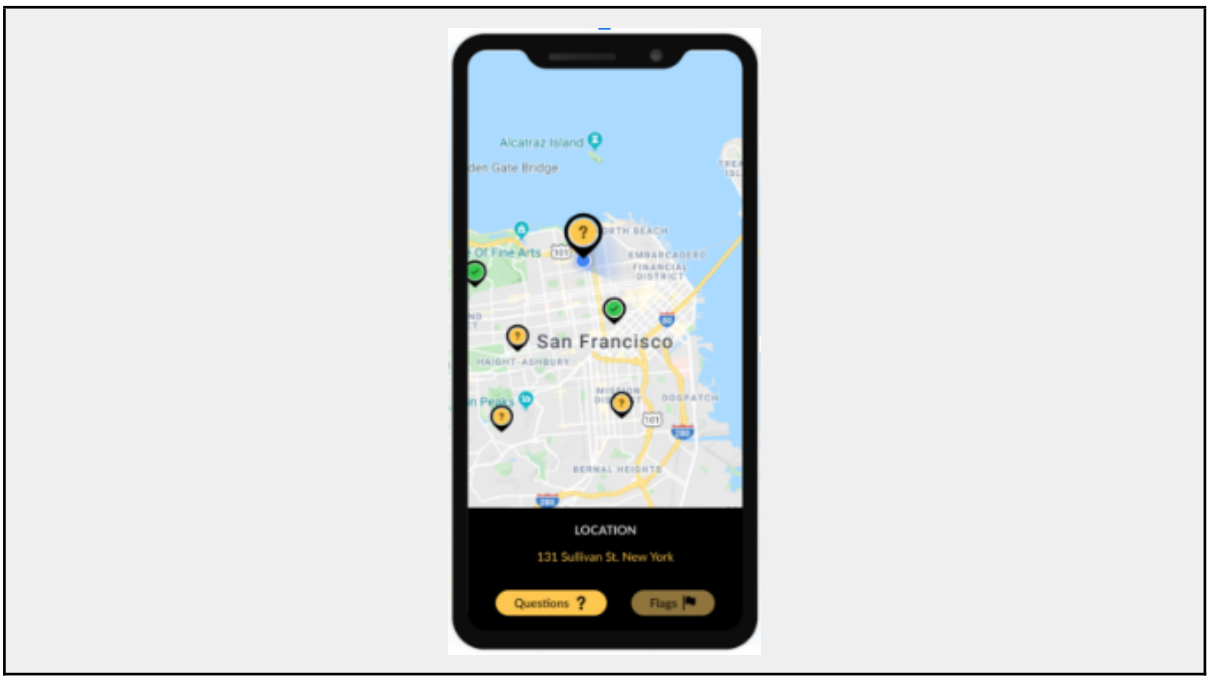

Figure 26. *Example of treasure hunt activity based on location-based AR* [206]

Escape classroom games work similar to the treasure hunt game activities; the escape classroom can use marker-based AR in order to engage students in a question and clue based activity to work on different topics and learning contents.

3.5 Task Design considerations

AR may have three main pedagogical uses: for information transmission activities where students access learning materials in context, for social constructivist activities, where students individually or in collaboration with other learners record, annotate, interact, modify elements of their virtual or real settings and for constructivist activities where learners design and build

[206] https://arvrtech.eu/treasure-hunt/

AR artefacts. [207] First, teachers can use AR for accessing information. In these activities, students scan learning materials like flashcards or real-life objects to access contextual content. For example, a student might scan a flashcard to see a 3D object or an animation, along with videos and audio to support vocabulary learning (e.g., Zapata-Paulini et al., 2023[208]). Similarly, a classroom storybook could be scanned to make characters or elements appear live in the room.[209]

Secondly, AR can be used for interactive and collaborative tasks. In these activities, students work individually or in groups to interact with virtual content in real-world settings. They might complete a location-based quest or mystery (e.g., Hellermann & Thorne, 2022[210]), communicate with a virtual avatar (e.g., Khodabandeh, 2023[211]), or attach virtual notes to physical objects. These tasks encourage active engagement and communication as students work together to solve problems.

Finally, AR can be used for student-created projects. In these creative activities, learners use AR tools and software to design and build their own AR experiences. For example, students might work in groups to develop an AR-based course or create scenes with dialogues in the target language that others can later play and interact with in a real-life context (e.g., Lee & Park, 2020[212]). This approach empowers students to become creators, not just consumers, of the AR experience.

Table 3 demonstrates examples of such implementations along with their description, intended goals, potential pitfalls, and examples. Part of this has been published in the context of the ARIDLL project in Christou et al. (2025).[213]

[207] Pegrum, M. (2021). *Augmented reality learning*. Innovative language pedagogy report, 115. p.116
[208] Zapata-Paulini, J., Beltozar-Clemente, S., Sierra-Liñan, F., & Cabanillas-Carbonell, M. (2023). Development and evaluation of a didactic tool with augmented reality for Quechua language learning in preschoolers. *Indonesian Journal of Electrical Engineering and Computer Science,* 30(3), 1548–1557. https://doi.org/10.11591/ijeecs.v30.i3.pp1548-1557
[209] Kuru Gönen, S. İ., & Zeybek, G. (2022). Using QR code enhanced authentic texts in EFL extensive reading: a qualitative study on student perceptions. *Education and Information Technologies*, 27(2), 2039–2057. https://doi.org/10.1007/s10639-021-10695-w
[210] Hellermann, J., & Thorne, S. L. (2022). Collaborative Mobilizations of Interbodied Communication for Cooperative Action. *Modern Language Journal*, 106, 89–112. https://doi.org/10.1111/modl.12754
[211] Khodabandeh, F. (2023). Exploring the viability of augmented reality game- enhanced education in WhatsApp flipped and blended classes versus the face-to-face classes. *Education and Information Technologies*, 28(1), 617–646. https://doi.org/10.1007/s10639-022-11190-6
[212] Lee, S.-M., & Park, M. (2020). Reconceptualization of the context in language learning with a location-based AR app. *Computer Assisted Language Learning,* 33(8), 936–959. https://doi.org/10.1080/09588221.2019.1602545
[213] Christou, E., Vassiliou, P., & Parmaxi, A. (2025). Augmented reality in language learning: A systematic literature review of the state-of-the-art and task design considerations. *Innovation in Language Learning and Teaching*, 1–28. https://doi.org/10.1080/17501229.2025.2504706

Table 3. *Task Design considerations in the use of AR for language learning (Adopted from Christou et al. 2025[214]).*

No	Task	Description	Intended Outcomes	Potential Pitfalls	Examples
1. Information transmission activities (students access learning materials in context)					
1	*Translating or visualizing information*	Scanning flashcards and QR codes for visualizing information in the target language Learners scan flashcards and QR codes that reveal 3D AR objects, animations or multimedia such as texts, videos, and audio in the target language.	To improve cultural and language skills such as vocabulary, grammar etc.	• Technological limitations and information overload • Distraction by technology (e.g. focus on sounds and images instead of vocabulary) • Arguing the effectiveness for non-visual learners • Classroom management difficulties	Geng & Yamada (2020) Zapata-Paulini et al. (2023)
		Scanning physical objects for visualizing information in the target language Learners scan a physical object around the classroom with AR-enabled devices. Scanning an object with an AR app superimposes audio-visual information in the target language.	To increase motivation and performance in language learning	• Unfamiliarity with the technology • Short time of implementation • Distraction of the technology due to its novelty • Physical discomfort such as dizziness	Binhomran & Altalhab (2021) Hung et al. (2023) Ebrahimi (2022)
2. Social constructivist activities (students individually or in collaboration with other learners record, annotate, interact, modify elements of their virtual or real settings)					
2	*Completing quests or missions*	Vocabulary and Grammar Practice Using HMD Glasses Learners practice vocabulary and grammar with fixed or adaptive associations, combining text and 3D virtual objects. Immediate assistance, resources specific to the learner's needs, and relevant feedback is used.	To enhance engagement and learning outcomes of the target language.	• Technical challenges with AR implementation. • Ensuring participant engagement and motivation.	Che Dalim et al. (2020) Weerasinghe, Biener et al. (2022)

[214]Christou, E., Vassiliou, P., & Parmaxi, A. (2025). Augmented reality in language learning: A systematic literature review of the state-of-the-art and task design considerations. *Innovation in Language Learning and Teaching*, 1–28. https://doi.org/10.1080/17501229.2025.2504706

		Completing language quizzes Learners are exposed to AR-supported flashcards, quests, matching cards, and puzzle applications with embedded QR codes for interactive digital content mainly for vocabulary learning.	To improve language skills in the target language	• Experiencing fear and difficulty related to handling the device • Technical challenges with AR tools • Ensuring engagement and motivation	Zuo et al. (2022) Rapti et al. (2023) Khamitova et al. (2023)
		Attaching virtual cards to physical objects Learners attach virtual sticky notes—each containing a target word to be memorised together with its corresponding source-language translation— to real-life objects (e.g. furniture in their homes or offices)	To improve the target language vocabulary	• Distraction from the familiar environment. • Limited transferability to other contexts. • Potential memory overload with too many sticky notes.	Costuchen et al. (2022)
3	*Collaborating in location-based exploration game/ mystery*	Location-based, collaborative problem-solving tasks Small groups of learners collaborate in an AR-based exploration game, interact with virtual characters, items, and media and follow in-app clues to discover their campus while developing language skills. Gameplay interactions take place in written text or audio and video recordings.	To improve language learning skills and collaborate	• Heavy reliance on technology and GPS may reduce critical thinking engagement. • Location accuracy • Technical issues with applications / devices • Student engagement and participation • Collaborative challenges and coordination • Instruction provided in AR might be challenging	Hellermann & Thorne (2022) Mei & Yang (2019) Thorne et al. (2021) Çelik & Yangın Ersanlı (2022)
		Location-based game scenario involving interaction with people and places Learners need to interact with people and places in the real world in a game-based environment.	To learn and practice new words and phrases in context	• Technical challenges and access. • User adoption and engagement.	Mozaffari & Hamidi (2023)
4	*Communicate with a virtual avatar*	Communicate with virtual avatar Learners place a virtual character within an AR game environment and guide them to a specific location.	To enhance English communication skills for tourism	• Technical issues with AR devices. • Learner engagement and motivation.	Khodabandeh (2023)

				• Limited access to smartphones.	
5	*Facilitating segmental production*	Using AR filters for L2 pronunciation Learners' segmental production and articulatory awareness of the targeted language consonants are facilitated through AR filters.	To improve pronunciation	• Balancing technology and language focus	Zhu et al. (2022)
3. Constructivist/ionist activities (learners design and build AR artefacts)					
6	*Creating AR artifacts*	Creating AR experiences Learners individually or in groups create AR content and artefacts (e.g. videos, brochures, presentations), and share them with the rest of the class	To motivate learners and improve their language skills with AR	• Difficulties due to software unfamiliarity and access • Technical issues (e.g. internet connection, accessibility)	Lin & Tsai (2021) Chien (2019) Karacan & Polat (2022) Lee & Park (2020)

3.6 Classroom Orchestration considerations

When using AR for language learning, teachers have a lot of flexibility in how they structure the classroom experience.[215]

3.6.1 Grouping: Individual vs. Collaborative Work

While some AR tasks are designed for individual learners, research shows a preference for students working in groups or pairs. Collaborative tasks, such as those in the "Chrono Ops" AR game[216], encourage peer interaction and teamwork. However, it's important to consider that not all students are comfortable with group work, so a mix of individual and collaborative tasks may be necessary to accommodate different personalities[217].

3.6.2 Location: Inside and Outside the Classroom

AR tasks are not confined to the traditional classroom. A major trend is to get students away from their desks and into the real world, a concept some researchers call "rewilding" language education. For example, a location-based AR game might require students to move around their university campus to solve problems related to green technology[218]. This approach connects formal learning with the real world, providing opportunities for unpredictable and authentic interactions. However, AR can also be used in more controlled settings. For example, students can be tasked with exploring AR content at home[219], or an instructor might set aside a quiet, dedicated space in the school for individual tasks that require good lighting and low noise, such as those involving speech recognition.[220] Overall, teachers have a wide range of options for where and how they implement AR, from individual home-based projects to collaborative outdoor quests.

3.7 What to keep in mind when incorporating AR in your classroom

Ultimately, the use of AR depends on different contexts, and teachers need to decide whether the use of AR is beneficial depending on specific situations and given the advantages and disadvantages of AR above. However, accessibility to phones and some familiarity with AR are always needed before deciding whether to use AR with learners.

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[215] Christou, E., Vassiliou, P., & Parmaxi, A. (2025). Augmented reality in language learning: A systematic literature review of the state-of-the-art and task design considerations. *Innovation in Language Learning and Teaching*, 1–28. https://doi.org/10.1080/17501229.2025.2504706

[216] Hellermann, J., & Thorne, S. L. (2022). Collaborative Mobilizations of Interbodied Communication for Cooperative Action. *Modern Language Journal*, 106, 89–112. https://doi.org/10.1111/modl.12754

[217] Mei, B., & Yang, S. (2019). Nurturing Environmental Education at the Tertiary Education Level in China: Can Mobile Augmented Reality and Gamification Help? *Sustainability* 2019, Vol. 11, Page 4292, 11(16), 4292. https://doi.org/10.3390/SU11164292

[218] Thorne, S. L., Hellermann, J., & Jakonen, T. (2021). Rewilding Language Education: Emergent Assemblages and Entangled Actions. *Modern Language Journal*, 105, 106–125. https://doi.org/10.1111/modl.12687

[219] Larchen Costuchen, A., Darling, S., & Uytman, C. (2021). Augmented reality and visuospatial bootstrapping for second-language vocabulary recall. *Innovation in Language Learning and Teaching,* 15(4), 352–363. https://doi.org/10.1080/17501229.2020.1806848

[220] Geng, X., & Yamada, M. (2020). An augmented reality learning system for Japanese compound verbs: study of learning performance and cognitive load. *Smart Learning Environments,* 7(1). https://doi.org/10.1186/s40561-020-00137-4

What to keep in mind when incorporating AR in your classroom

Define the added value of AR. AR needs to add value to language teaching and learning; it needs to be meaningful and aim at reaching specific Learning Objective(s). For certain tasks, technology like AR may not be the best solution, but circumstances, such as economic or practical constraints, create a situation where using AR is the better option. For instance, when using real-life objects with a big class, it can be more time efficient, safer or less costly to let students interact with the object in AR rather than with a real object in class.

Task Design Considerations. Align AR activities with one of three main pedagogical purposes: (1) Information transmission (accessing contextual learning materials), (2) Interactive/collaborative engagement (problem-solving with virtual content in real-world settings), and (3) Student-created AR projects (designing AR artefacts for authentic language use).

Classroom Orchestration Considerations. Plan for flexible grouping (balance individual and collaborative work to suit diverse learner preferences) and varied locations (combine in-class, outdoor, and home-based AR activities to blend formal learning with real-world, authentic interaction).

Consider students' level. AR in the classroom is only useful if the AR task is appropriate for students' levels. It might be the case that learners need pre-tasks (e.g., pre-taught vocabulary) to be able to do an AR activity. Teachers need to ensure that an AR activity supports the learner's language development and is neither too easy nor too challenging.

Consider students' cognitive pressure. AR should not be used if it introduces too much extraneous cognitive load, i.e. the type of load created by the way information is presented to users. If the cognitive load is too high, less capacity will be left for learning.

Ensure accessibility. When using phones for AR, it is important to check beforehand whether all participants have access to a phone and whether the available phones have the necessary hardware and software. Older phones may cause problems as they often do not have the necessary processing power, lack required sensors (e.g. depth sensors) or software (e.g., software to process QR-codes).

Familiarisation with AR. It is important that users of AR content have some experience with the device(s) being used and are familiar with the use of AR applications. Without being familiar with AR in general, using AR might not be very effective because users cannot focus on the educational experience. In other words, users need some introductory AR training before using AR for educational purposes.

Section 4: Scenarios and task design examples using AR

4.1 Scenarios in the use of AR in language learning

This section demonstrates real life scenarios and task design examples in AR. The tasks were retrieved from rescind research published in the field and/or applications of AR in real-life classrooms.

Table 4. *Examples of scenarios in the use of AR in language learning.*

Task Design	Description	Intended goal	Functionality options	Affordance	Potential pitfall	Indicative reference
Using AR flashcards	Students use AR flashcards for vocabulary learning (early childhood education.	To learn the animals through AR flashcards and put them into categories, like mammals, sea creatures etc.	A set of AR flashcards was selected where students experienced them through iPads.	Learners can scan the flashcards, interact with the virtual objects (rotate, make them move or even take pictures of them) and observe their special features from a close distance.	-Children distracted by the technology - Teachers struggle with managing the whole class using AR flashcards.	Chen and Chan (2019) [221]
Integrating computer generated images and media in physical space	Students participate in a story based virtual treasure hunt game in L2. A series of challenges in the form of written or video recordings as well as map exploration and collection of virtual objects, guide them from one clue to the other in order to win the game.	To practice vocabulary in a real-like context.	Students interact with multimedia stimuli ranging from written text to audio or video recordings.	Students improve their productive and receptive skills in L2 in an AR environment.	Students need effective and sufficient scaffolding while playing the game.	Perry (2015) [222]

[221] Chen, R. W., & Chan, K. K. (2019). Using augmented reality flashcards to learn vocabulary in early childhood education. *Journal of Educational Computing Research*, *57*(7), 1812–1831. https://doi.org/10.1177/0735633119854028

[222] Perry, B. (2015). Gamifying French language learning: A case study examining a quest-based, augmented reality mobile learning-tool. *Procedia – Social and Behavioral Sciences*, *174*, 2308–2315. https://doi.org/10.1016/j.sbspro.2015.01.892

Engage in dialogue to solve tasks	Students use location based AR software and engage in dialogue to solve tasks.	To construct narrative To learn target vocabulary.	Location-based AR software	Opportunities for open-ended dialogues and situation-driven vocabulary are provided through AR games. AR games can be considered a meaning-oriented language learning task create opportunities for just-in-time and situationally driven vocabulary learning.	Difficulties with in-game prompts	Sydorenko et al. (2019) [223]
Creating collaborative AR projects	Students (teacher-candidates) develop their own AR projects which aim at teaching English to young learners.	To identify the teacher candidates' attitudes towards the adoption of AR after developing their own collaborative AR projects and which technological and pedagogical skills do they need to have.	Teacher candidates chose the AR app that best suited their needs. Zapworks, Roar, Vuforia were some of the apps used since their distinctive functionality options of triggering, overlaying, tracking etc sufficed the needs of the proposed AR experiences they developed.	-Teachers-candidates expressed their satisfaction and pleasure designing AR projects for different activities like a history period and learning clothes.	-Free versions of AR tools have limited functionalities (lack of image sensitivity, cloud storage capacity, limited number of scans, lack of compatibility between different operating systems, limited re-editing options and short-term availability). - Lack / need of training	Belda-Medina et al. (2022) [224]

[223] Sydorenko, T., Smits, T. F. H., Evanini, K., & Ramanarayanan, V. (2019). Simulated speaking environments for language learning: Insights from three cases. *Computer Assisted Language Learning*, *32*(1–2), 17–48. https://doi.org/10.1080/09588221.2018.1466811

[224] Belda-Medina, J., & Calvo-Ferrer, J. R. (2022). Preservice teachers' knowledge and attitudes toward digital-game-based language learning. *Education Sciences*, *12*(3), 182. https://doi.org/10.3390/educsci12030182

Vocabulary learning through marketless and marker based AR	Kindergarten students engage in vocabulary learning through mini games and/or the displaying of virtual objects (markerless and marker based AR).	To acquire topic based vocabulary and word spelling.	Learners familiarise themselves with different vocabulary items and interact with them. There is an option for games. The app involves class statistics for learners' progress.	Markerless AR is more suitable for the age of kindergarten students -Teachers and parents commented favourably on the application -Students seemed more focused and showed increased levels of motivation.	The camera of the mobile device sometimes loses focus and the object scene needs to be reset. If more 3D objects are added then the response time of the application will be greatly affected. -Limited vocabulary topics (animals, fruit, vehicles).	Lee et al. (2019) [225]
Vocabulary learning through Quiver Vision colouring pages	Learners colour the pages the teacher has downloaded from QuiverVision. Then they interact with the 3D effects that are integrated in their drawing while using the app from their devices.	To learn targeted vocabulary in a playful and engaging way.	QuiverVision Colouring pages act as trigger points and learners' drawings come 'alive' when scanned.	Learners showed great improvement in learning performance, motivation and confidence.	Students lost focus and were distracted by the augmentations.	Tsai (2020) [226]

[225] Lee, L. K., Chau, C. H., Chau, C. H., Ng, C. T., Hu, J. H., Wong, C. Y., Yu, L. C., & Wu, N. I. (2019). Improving the experience of teaching and learning kindergarten-level English vocabulary using augmented reality. *International Journal of Innovation and Learning*, *25*(2), 110–125. https://doi.org/10.1504/IJIL.2019.097661

[226] Tsai, C.-C. (2020). The effects of augmented reality to motivation and performance in EFL vocabulary learning. *International Journal of Instruction*, *13*(4), 987–1000. https://doi.org/10.29333/iji.2020.13460a

CLIL lesson: The solar system Involving vocabulary and skills development	Primary school learners follow the guidelines to explore the location of different planets in the solar system and their distances from the sun	To improve content learning in terms of the solar system, vocabulary related to the topic as well as skills development especially speaking, reading and listening.	The activities ranged from basic cognition of concepts and targeted vocabulary to an inquiry-based activity which provided opportunities for self-checking and instant feedback.	Positive attitudes towards learning, increased interest, provision of real context in communications and opportunities for interaction in groups.	Pre-training on how to use the app is required both for students and teachers. Teachers also need further training in order to design and develop an AR experience suitable for their students' needs.	Liu et al. (2018) [227]
Speaking and listening practice through game-based activity developed with ARTutor	Secondary and tertiary learners engage in information exchange to solve game-tasks (*Who am I?*)	The aim is to practice and strengthen oral skills (listening and speaking).	The activity is a game-based activity in which learners must work in small groups to describe and guess different famous people, practising the vocabulary and questions they have learnt previously in class.	Learners showed great engagement and motivation to exchange information with their game partners.	The activity didn't require solely a small introduction regarding the functioning of the app design and the dynamic of the activity to be performed.	Valero Franco & Berns (2024)[228]

[227] Liu, E., Liu, C., Yang, Y., Guo, S., & Cai, S. (2018). *Design and implementation of an augmented reality application with an English Learning Lesson* (pp. 494–499). https://doi.org/10.1109/TALE.2018.8615384

[228] Valero-Franco, C., & Berns, A. (2024). *Development of virtual and augmented reality apps for language teaching: A case study*.[Desarrollo de apps de realidad virtual y aumentada para enseñanza de idiomas: Un estudio de caso]. *RIED-Revista Iberoamericana de Educación a Distancia,* 27(1), 163-185. https://doi.org/10.5944/ried.27.1.37668.

Listening and reading task to acquire vocabulary and grammar	Secondary and tertiary learners use the Merge Cube and their smartphone to access a vocabulary learning app (*Objects and prepositions*) designed with Delightex.	The aim is to acquire and strengthen vocabulary and grammar through different listening and reading tasks.	Learners access different learning tasks by scanning a QR code previously generated and associated with the AR activity developed. To access the augmented learning content they use their smartphones and a Merge Cube (https://mergecube.com/paper-pdf).	Learners showed great engagement and motivation when using this innovative technology, and they enjoyed the learning experience very much. However, some learners emphasised the importance of having both paper-based and technology-based learning materials.	A short technical and pedagogical introduction is required to help learners make the most of the learning tool.	Berns & Valero-Franco (2024, 2025)[229]

[229] Berns, A., & Valero-Franco, C. (2024). Embracing transition: The impact of emerging technologies on language learning pedagogies. *Proceedings of the International CALL Research Conference*, *2024*, 15–22. https://doi.org/10.29140/9780648184485-03;
Berns, A., & Valero-Franco (2025). From users to creators: Harnessing Extended Reality and End-User Development tools in Language Education. In A. Alm, C. Lai, & A. Ma (Eds.), *Transitions in CALL*, Castledown Publisher. *Transitions in CALL*. Castledown Publishers. https://doi.org/10.29140/9781914291272 (forthcoming).

4.2 Short scenarios / Possible AR ideas for in class implementation

Murphy & Friends I - Speaking and Creative Writing

Educational level	Learning Objectives	AR app	Video	Benefits	Challenges	The activity at a glance
Primary school 8-10 yrs old A2 CEFR	To practise creative story writing To practise vocabulary	Quiver	Murphy & Friends Games[230]	Increased learner motivation and task engagement	Students might get distracted easily from the interactive features of the app.	Students colour their favourite characters and engage themselves in creative story writing. They write about Murphy's and his friends' free time activities on a weekly basis

Time: 45'

Materials:

Flashcards with free time activities/ hobbies

Murphy and friends Edu Games colouring pages[231] from Quiver

Quiver app on tablets on mobile

Procedure

Warm up

1. Ask learners about their hobbies and free time activities. How do they usually spend their free time in the afternoons? Encourage them to talk to their partners about a typical Wednesday afternoon.
2. Learners present to the class everything they have learnt from their partners eg. favourite hobbies / how they spend their afternoons etc
3. Write on the class board everyone's contribution and discuss the most popular hobby according to the class presentations.

[230] https://youtu.be/aR7AXQT-dDg
[231] https://quivervision.com/coloring-packs/Murphy-and-Friends-Edu-Games

During the activity

1. Give students the colouring pages[232] of Murphy and friends (one per student) and give them time to colour the pages.
2. Use a tablet / mobile to augment students' drawings.
3. Ask students 'What does Murphy usually do before / after playing football?' , 'How does he spend his Mondays, Tuesdays, etc?'
4. Write all the answers on the board.

After the activity

1. Ask learners to write a short paragraph about what Murphy and / or his friends usually do in their afternoons.
2. Encourage learners to use the ideas on the board and create Murphy's weekly plan of free time activities.

Murphy & Friends II - Free time activities / Hobbies

Educational level	Learning Objectives	AR app	Video	Benefits	Challenges	The activity at a glance
Primary school 7-9 yrs old A1 CEFR	To revise vocabulary related to hobbies and free time activities To develop their speaking and listening for details about favourite free time activities To practise asking and answering about likes and dislikes 'Do you like ... ? Yes. I do/ No, don't'	Quiver	Murphy & Friends Games[233]	Increased learner motivation and task engagement	Students might get distracted easily from the interactive features of the app.	Students colour their favourite characters and engage themselves in speaking about their free time activities and/or pretending to be Murphy himself!

Time: 45'

Materials:

Flashcards with free time activities/ hobbies

[232] https://quivervision.com/coloring-packs/Murphy-and-Friends-Edu-Games
[233] https://youtu.be/aR7AXQT-dDg

Murphy and friends Edu Games colouring pages[234] from Quiver

Quiver app on tablets on mobile

Procedure

Warm up

1. Present the flashcards to the learners one after the other or by revealing them gradually. Learners call out the name of the free time activity
2. Play 'What's missing?' on the board. Place the flashcards on the board. Ask learners to close their eyes and remove one flashcard from the board. Tell students to open their eyes and ask them 'What's missing?' Play the game a few times

During the activity – Find your free time activity buddy

1. Ask students to draw on a small piece of paper their favourite activity. Ask them to keep their drawing private and not to show it to anyone.
2. When everyone is finished, encourage students to move around and ask as many people as possible 'Do you like... (the name of the free time activity they have drawn)?
3. When they find someone with the same interests they stay together and they ask the same questions in order to find more buddies.
4. Learners in groups of similar interests present to the rest of their classmates their favourite free time activities. Eg. We like football. We play football everyday / in the afternoons etc

After the activity

1. Give students the colouring pages[235] of Murphy and friends (one per student).
2. Ask them to guess what the favourite free time activities of these characters are.
3. Give students time to colour the pages and then use a tablet / mobile to augment their drawing.
4. Encourage learners to present the free time activity they have augmented, introduce the characters, the sport they play, how often they play, why they like it etc. Alternatively, they can pretend to be Murphy himself and give voice to this little fellow!
5. Murphy and his friends will come alive and learners can play interactive games with them while using the app.

[234] https://quivervision.com/coloring-packs/Murphy-and-Friends-Edu-Games
[235] https://quivervision.com/coloring-packs/Murphy-and-Friends-Edu-Games

A Guessing Game - Wild animals

Educational level	Learning Objectives	AR app	Video	Benefits	Challenges	The activity at a glance
Primary / Secondary school 8-11 / 12- 14	To practise listening for specific information To practise speaking / describing animal features Speaking / Listening	ARloopa	ARloopa - How to View Model - Tutorial[236]	Increased learner motivation and task engagement	Students might get distracted easily from the interactive features of the app.	Students use the augmentation of a wild animal and talk about it to their partner(s) who try to guess it based on what they hear.

Time: 10'

Materials: ARloopa app on tablets or mobiles

Procedure

Warm up

1. rainstorm as many wild animals and write them on the board
2. Ask learners if they have seen any of those animals from a close distance. If yes, how did they feel?

During the activity

1. Ask students to get in pairs or in small groups of threes
2. Tell them that they are going to play a guessing game.
3. One of them will decide to augment a wild animal from the ARloopa app and s/he will describe it in as many details as possible (according to their level of English)
4. The other player(s) guess and then they swap roles.

After the activity

1. Learners reflect on the activity and comment on how they felt observing a wild animal from such a close distance
2. They choose one of the animals they have described to their partners and look for more information about it on the internet.
3. They prepare a small presentation about it either in class or at home.

[236] https://youtu.be/tZDfHuHHkOE

A Tour ARound London

Educational level	Learning Objectives	AR app	Video	Benefits	Challenges	The activity at a glance
Primary / Secondary / Tertiary 11 - 91 yrs old	To practise speaking and presentation skills To practise listening for details To practise writing and note taking	ARTutor4	Video[237]	Rich stimuli for practising receptive and productive skills. Increased motivation and task engagement for learning in an authentic context	Poor internet connection might create problems with the augmentations if a lot of devices are used simultaneously.	Students visit famous London sights and learn interesting facts about them without leaving their classroom

Time: 90'

Materials

ARtutor4 on tablets or mobiles

A map of central London with paper miniature of some of the most popular London sights

A worksheet with hits on what information to note down during their AR guided tour experience

Before the activity

Ask students if they already know any famous London sights and / or if they have ever visited London.

Tell them to get in pair and ask them to choose one of the London sights mentioned before

Give each pair a worksheet and ask them to note down information related to 'Where the sight is, what someone can see / do there, the entrance cost (if any), their personal impressions, whether they would recommend visiting it and anything else they feel is important mentioning about it.

During the activity

Learners work in pairs and use their tablets and mobiles to augment the sights and collect the information they need. They can access the information and the videos provided as many times as they wish

After the activity

Students use the information they have collected or search for more on the internet and they prepare an oral presentation and / or a poster about the sight they have

[237] https://www.canva.com/design/DAE3B7eR0dg/KidrybhLFzobJ8Am27ol0w/watch

visited

The rest of the class attends the presentations and make clarification questions

At the end the class can vote for the best presentation and the most interesting sight to visit in reality!

A Unique Advent CalendAR

Educational level	Learning Objectives	AR app	Video	Benefits	Challenges	The activity at a glance
Primary / Secondary / Tertiary 8-88 yrs old	To practise speaking / presentation skills To practise listening for details and for gist To practise reading for details and for gist To practise writing and note taking	ARTutor	Video[238]	Rich stimuli for practising receptive and productive skills. Increased motivation and task engagement Raise cultural awareness about Christmas customs around the world	It might be time consuming for everyday lessons.	An augmentation for everyday of December up until Christmas gives learners access to a variety of songs, traditions, games, stories, crafts etc Learners get inspired and experience an augmented advent period!

Time: 10'

Materials

An advent calendar of any shape or material that holds the trigger points for the augmentations from the 1 until the 24 of December. A mobile or a tablet with ARtutor 4.

Procedure

Everyday a student or a pair of students are responsible for augmenting the corresponding date. Their duty is to listen and/or watch to the song, santa's message, recipe, craft etc and to present it to their classmates in as many details as possible.

Alternatively, learners can simply use their devices and access the augmentations by themselves and enjoy the hidden surprises!

[238] https://www.canva.com/design/DAFQQSDFMJY/VsekPnRU3lp3QVSnszTzgQ/watch

All about Flags

Educational level	Learning Objectives	AR app	Video	Benefits	Challenges	The activity at a glance
Primary / Secondary / Tertiary 8-88 yrs old A1 - B1 CEFR	To practise speaking - describing a flag (shapes and colours) To practise listening for details To enhance cultural awareness, develop self-confidence	Quiver	Video[239] Flag - QuiverVision[240]	Increased motivation and task engagement Raise cultural awareness and self-confidence	Students might easily get distracted by the interactive features of the app	Students colour flags and talk about them. Alternatively, they can design a flag for their school / club / team and present them.

Time: 30'

Materials

Quiver flag colouring pages

A tablet or a mobile with Quiver app

Procedure

Warm up

Show students different flags and ask them 'Do you know which flag is this?'

Play memory games if you have enough printed cards or use an online memory game from Wordwall or Quizlet

During the activity

Ask students to choose the flag they wish to work on

Give students a Quiver Flag colouring page[241] and ask them to colour it

Students use the app and augment the flag.

They present their augmentation to the rest of their classmates and they talk about the flag's colours, country / nationality and the reason they have chosen to augment it, for example, the things they like about that country, the last time they have visited it and / or any interesting facts they know about it.

After the activity

Create a collaborative AR poster, which can be accessed by everyone who has the app. Students' presentations can also be recorded and added on an ebook about different

[239] https://www.canva.com/design/DAFQT9jE-wE/YYLeem5RA9U2A1BnCVwCow/watch
[240] https://www.youtube.com/watch?v=KtcsE_oaF3w
[241] https://quivervision.com/coloring-packs/Education-Starter-Pack

countries and shared on the class / school's blog as a project.

Lost luggage

Educational level	Learning Objectives	AR app	Video	Benefits	Challenges	The activity at a glance
Age: 12-14 years old Level: B1/ B1+ CEFR	To practise speaking - describing objects and listening for details To practise modal verbs to express logical assumptions To engage learners in creative story writing	Artutor4	N/A	Rich stimuli for practising receptive and productive skills. Increased motivation and task engagement for learning in an authentic context	Poor internet connection might create problems with the augmentations if a lot of devices are used simultaneously.	Learners discuss personal experiences about travelling by plane, airports and lost luggage. They make logical assumptions using *might/ could/ may* etc and at the end they are engaged in creative story writing about the owner of the AR suitcase.

Time: 45'

Materials:

1. A Sketchfab augmentation of a suitcase
2. A photo of an airport terminal
3. ARTutor4 on tablets or mobile phones

Procedure

Warm up

Show the picture to the learners and ask them:

a. Have you ever been to an airport?
b. When was it?
c. Where did you go?
d. Did you have a suitcase with you? What did you pack?
e. What would you do in case you lost your luggage?

During the activity

Ask learners to get in pairs and scan the photo you have given them.

a. In pairs they talk about the AR luggage they see in front of them by answering the following questions:
    i. Whose suitcase is this?
    ii. Where is this person going?
    iii. What is in the suitcase?
    iv. What is this person like?
b. Encourage them to use modal verbs like It might / could / must be...
c. Learners report to the class their assumptions and they justify their answers to the best of their abilities.

After the activity

1. Write everyone's assumptions on the board to create a bank of ideas
2. Invite learners to write a story about the lost luggage at the airport. Ask learners to narrate the story from different points of view. They can take up the role of the traveller, the suitcase itself or the person who has found it and delivered it to the airport security.

Language Teaching with AR technology (CHECKLIST)

1. Clarify Your Teaching Goal

- ☐ Define the specific learning objectives you want to achieve with AR.
- ☐ Link AR goals to CEFR.
- ☐ Identify which language skills the AR activity will target (speaking, listening, reading, writing, or integrated skills).
- ☐ Plan how AR features will specifically support skill development.

2. Identify the Pedagogical Approach

- ☐ Determine the teaching method that aligns with your goal (e.g., constructivist, experiential learning, situated learning).

3. Task Design Considerations

- ☐ Match AR activity to one of the three pedagogical purposes:
  - Information transmission (contextual learning materials)
  - Interactive/collaborative engagement (real-world problem-solving)
  - Student-created AR projects (designing AR artefacts)
- ☐ Ensure tasks support active engagement and authentic language use.

4. Classroom Orchestration Considerations

- ☐ Plan for flexible grouping:
  - Include both individual and collaborative options.
  - Accommodate different learner preferences.
- ☐ Vary activity locations:
  - Use in-class, outdoor, and home-based settings.
  - Connect classroom learning with authentic, real-world contexts.

5. Design Learning Activities

- ☐ Plan activities that will help students grasp the targeted content using AR.

6. Select an AR Tool

- [ ] Choose an appropriate AR tool that fits your teaching and learning objectives.

7. Check Accessibility

- [ ] Verify that the AR tool accommodates learners with disabilities (visual, auditory, motor impairments).
- [ ] Ensure alternative modes or accommodations are available for all students.

8. Check Device Availability

- [ ] Verify if institutional devices are available or if students can use their own devices.

9. Prepare Devices

- [ ] Ensure all mobile devices are fully charged.
- [ ] Confirm that all mobile devices are ready to be used.

10. Check Internet Connectivity

- [ ] Ensure Wi-Fi is available on students' devices.
- [ ] If Wi-Fi is unavailable, plan to use a hotspot from the instructor's mobile device.

11. Design AR Activity

- [ ] Develop a structured AR activity that aligns with your learning goals.

12. Before in-class use

- [ ] Check if the AR application works properly.
- [ ] Run a test with a small group of students to ensure that the application and augmentations run smoothly
- [ ] Ensure the AR application is up-to-date.

- [ ] Identify low-tech alternatives that still meet learning objectives.

13. During in-class implementation

- [ ] Introduce the lesson topic.
- [ ] Demonstrate how to use the AR application.

- [ ] Set clear behavioral expectations for device use and AR exploration.

14. Facilitate Student Interaction with AR

- [ ] Encourage students to use their devices to see AR augmentations.
- [ ] Allow sufficient time for students to explore the AR technology and ask questions.
- [ ] Be prepared with solutions for common technical issues (app crashes).
- [ ] Have a designated tech support strategy (peer helpers, instructor assistance, technical contact).

15. Support Peer Learning

- [ ] Create groups to facilitate peer learning
- [ ] Allow space between groups to minimize distractions
- [ ] Invite students who are familiar with AR technology to assist their peers.

16. Reinforce Learning

- [ ] Encourage students to revisit tasks to reinforce their learning and deepen understanding.

17. Assess and Reflect

- [ ] Measure learning outcomes against the original objectives.
- [ ] Collect student feedback on the AR experience and its effectiveness.
- [ ] Review and reflect on what worked well and what didn't. Document strengths and weaknesses encountered. Identify adjustments needed for future AR implementations.