Language and AI in Asia

Augmented Reality, an experiential language learning encounter

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Abstract
The democratisation and ubiquity of the smartphone has made it possible to integrate immersive technologies, including Augmented Reality (AR), into the language classroom. The effectiveness of AR has been extensively researched, but not always from a psychological point of view. This paper therefore aims to discuss the effectiveness of AR according to the user's degree of perception in a heterogeneous, multilingual teaching context that explicitly favours digital educational practices. To this end, quantitative and qualitative data collected through anonymous questionnaires from 2 case studies were analysed. This analysis points to the fact that the pedagogical role, i.e., the learner or the teacher, may influence the degree of perception of AR. In addition, the novelty and particularities of AR do not make it a common and easily accessible technology, even for users familiar with other educational technologies. Hence the integration of AR requires progressive and proactive planning, including purely technical hands-on workshops for both sides of the classroom, to achieve the most satisfactory learning experience possible.

Keywords
Augmented Reality (AR), perception, adult language teaching

Introduction

Context

The effort of addressing equally different and varied needs in education still retain the attention of teachers, as human flows continuously reshape learner diversity in the classroom. At times challenges or opportunities, globalisation has greatly impacted the educational sphere, redefining pedagogical expectations as well as the teacher's role in the process (e.g., Günther-Van Der Meij & Duarte, 2022; Wu, 2022). For language teachers in particular, globalisation has a special significance: be it even only for educational or economic purposes, learning the language of the new community is key for integration (Punar Özçelik et al., 2022: 134).

In this context of a globalized classroom, an inclusive approach is advocated to manage diversity and accommodate the learners' differing needs (Arneton et al., 2022: 69). Among other strategies, technology-enhanced learning is regarded as a compelling response to this inclusive expectation (Sandberg et al., 2022), while yielding multiple additional benefits for language learners (e.g., Mallahi, 2022; Milanovic, 2010).

Although increasingly widespread, IT equipment's availability is still far from perfect, highlighting the social and digital divide that may question technologies' usefulness in the classroom. In Luxembourg, however, considerable efforts have been devoted to make digital equipment widely accessible, thus empowering schools and teachers to further pursue digital education policies (e.g., "L'équipement numérique", 2022; Le Gouvernement Luxembourgeois, 2020; Reuter, 2022). These efforts and policies build a trend towards digitalisation that the University of Luxembourg also abides by (Kambala, 2023), as it too - just like the country of which it is a microcosm[i] – brings together heterogeneous plurilingual communities[ii] (Garcia, 2014; Laurent & Doré, 2022; MENJE, 2022).

Over the past years, following the changes brought by globalisation and digitalisation, teachers have thus continued to rely on technical and technological advances to stimulate, support and differentiate language learning (Marín-Díaz, 2017: 126). Moving away from the computer and the internet, the notable technological milestones of the 1980s (Karsenti, 2004), the rise of portable devices, such as smartphones, has enabled a new range of technologies to access the classroom. This new range of technologies includes emerging technologies, of which immersive technologies and in particular, Augmented Reality are representative examples.

Background

Immersive technology and Augmented Reality

Immersive technology can be generically approached as a "technology that blurs the boundary between the physical and virtual worlds" (Suh & Prophet, 2018: 77).

This difference between perceived worlds highlights how immersive technology relies on delivered *sensory and tracking information* to bring about an immediate and interactive user *experience* (Ali, 2022: 18; Hein et al., 2021: 119; Suh & Prophet, 2018: 77). This explains why immersive technology creates, as its name suggests, a sense of *immersion*[iii] (e.g., Ali, 2022: 13; Suh & Prophet, 201: 78-79).

If defined by objective technological factors, immersive technology can be classified by the degree of immersion it holds (Hein et al., 2021: 123). From this point of view, there is not just one immersive technology, but rather several technologies that are subsumed under the term *immersive technology* (Hein et al., 2021: 118; Suh & Prophet, 2018: 78). As a result, immersive technology[iv] can be sorted out on a reality-virtuality continuum, comprising technologies such as *Virtual Reality* (VR) or *Augmented Reality* (AR) (Suh & Prophet, 2018: 78-79).

VR and AR do not provide identical sensory and tracking information to the user. VR "creates a complete, artificial virtual environment and thus offers complete virtualization" (Hein et al., 2021: 118). On the contrary, AR punctually "allows for the superimposing of computer-generated virtual 3D objects on top of a real environment in real time" (Iqbal et al., 2022: 1).

A consequence of this fixed virtual overlay is that AR "typically [requires] something in the real world [to trigger] the virtual simulation" (Gonzalez et al., 2021: 2). These *triggers* (or *markers*) can be activated either by image recognition or by the location of the user (GPS). These types of AR are respectively categorized as *vision-based* and

location-based. Vision-based AR can be further subdivided according to the type of image recognition technique. On the one hand, if a specific trigger like a QR code or an image is needed, AR is said to be *marker-based*. If on the other hand, the immediate environment surrounding the user triggers AR, it is referred to as *markerless* (Punar Özçelik et al., 2022: 132).

The effectiveness of immersive technology

The "effectiveness of immersive learning with the use of technology" (Ali, 2022: 14), esp. of AR in education, has been widely documented (Punar Özçelik et al., 2022: 131). Its effectiveness from a psychological perspective however still needs to be further discussed (Chen & Wang, 2018: 705). To this end, this paper's discussion on AR's effectiveness will focus on the user perception, i.e., the learner perception.

The degree of perception, including information transferability to real life, is a highly decisive interrelated concept that is influenced by four factors: "accuracy of the virtual environment, immersion, presence, and user acceptance" (Ali, 2022: 14). Literature defines "*learner perception* of an AR-mediated environment (…) as the experience of learning through AR and interacting with such an environment" (Chen & Wang, 2018: 696). In this framework, high *accuracy of the virtual environment*, i.e., the ability to imitate the real world, will positively impact both constitutive variables of the learner perception (Marcassi et al., 2002: 311; Research Center Rennes-Bretagne-Atlantique, 2012: 2).

A satisfactory learner perception induces in turn a major psychological effect, i.e., an increased learner presence[v] (Chen & Wang, 2018: 695-697). By *learner presence* is meant the "human reaction to a system of a certain level of *immersion*[vi] and thus describes a subjective state" (Hein et al., 2021: 119).

An increased learning presence, for which the interaction experience is a good predicator, can finally be correlated with more successful learning outcomes (Chen & Wang, 2018: 705-706). Nevertheless, if the learner does not perceive any potential usefulness and ease of use with the technology (following Technology Acceptance Model), s/he will most likely have little to no intentions to use the technology, which equates to poor *user acceptance* (Cabero-Almenara et al., 2019: 2-3; Suh & Prophet, 2018: 81) of the learning experience and in turn, unsatisfactory learner perception. This attitude and intention to use a technology is moreover further influenced by external variables, such as age, experience in the use of technologies, professional level, and personal tendency towards innovation, to name but a few (Cabero-Almenara et al., 2019: 2).

Research aim

Augmented Reality is deemed to be "one of the fastest-growing sectors with an impact on Education" (Belda-Medina & Calvo-Ferrer, 2022: 12124). Meanwhile, AR is only "timidly (…) introduced in the educational sphere as shown by the view of the students" in certain studies (Marín-Díaz, 2017: 138).

The specific context of the University of Luxembourg, which actively promotes digitalized educational practices and has a proven past track record of language learning diverging needs, provides an appropriate framework to explore how the students perceive Augmented Reality in the classroom. Our research hypotheses can be formulated as follows:

(1) Students perceive Augmented Reality as an uncommon but effective learning tool.

(2) Students' familiarity with other educational technologies is a key factor in their acceptance of AR.

Methodology

Two case studies were conducted regarding AR. Their results were compiled and compared in a multiple case study to discuss the research question and hypotheses.

The first case study was integrated in a face-to-face mandatory lecture on language and media didactics and involved 17 aspiring high school teachers. These 13 female and 4 male participants, 88% of whom were between 20 and 30 years old, experimented with AR, first as users and then, as developers. This AR sequence was not foreseen

as an in-depth technical training, but rather as an introduction to the topic of AR in education. A lecture presenting what immersive technologies and AR are, as well as a session focusing on trial uses of vision-based marker-based and markerless AR activities were scheduled. The first case study collected aspiring teachers' perceptions via an anonymous questionnaire. Given the place assigned to digital didactics in the curriculum of these aspiring teachers (University of Luxembourg, Programme du master en éducation, langues et littératures françaises), this first case study involved a two-stage data collection process. A first anonymous online questionnaire collected the pre-service teachers' perceptions prior to any lectures or uses of the technology. The main aim of this first questionnaire was to assess whether AR had already been taught in another course. The second anonymous online questionnaire assessed the aspiring teachers' perceptions following the autonomous design of a 10min. AR activity that could be used in a real class setting.

The second case study was carried out as part of an online multilingual preparatory course for international mobility. It involved 5 female and 2 male students aged between 20 and 30 and with an average B1/B2 level in the target language. Thematically, the AR sequence developed for this course focused on language registers, on which the students worked in small groups per target language (2 students for French and 5 for German). For this AR sequence, the language learners were presented with a problem-based assignment requiring them to use a commercial (vision-based markerless) AR application to choose furniture. After their selection, the students would advocate for the purchase of the furniture of their choice in two written productions. The argumentation was supported by a visual (i.e. a printscreen of the device used during the AR sequence) showing the full-sized furniture in AR in the accommodation of one of the students of the workgroup. Unlike the first case study, the perceptions of the participants of case study 2 were collected via a single anonymous online questionnaire.

All questionnaires were structured using close-ended questions or four-point Likert scales. Open-ended questions, for the most part mandatory, were systematically paired with the former question types to gather qualitative information on the participants' opinions. A short follow-up discussion was then carried out in class.

Results

The first research hypothesis we formulated questioned whether students would perceive AR as an uncommon but effective learning tool. To this end, we first checked whether our participants had prior knowledge or experiences. In both cases, aspiring teachers (case study 1) and language learners (case study 2) predominantly reported little to no knowledge about AR. In the second questionnaire, this rate increased for aspiring teachers to reach a percentage similar to that of language learners, i.e., after the introductory session (from 52.9% to 87%).

However, this general lack of prior knowledge or experience did not work as a good predicator of the degree of perception, as both case studies resulted in very different overall degree of perception.

In the second case study, about 71% of the group found AR to be beneficial. Language learners justified their degree of perception essentially from the point of view of user acceptance and presence. They reported a good degree of perceived enjoyability, given that they could interact with the AR content and directly observe the results of their actions in their own home. In addition to this personal and contextualized learning setting triggered by AR, the students also highlighted the dynamism of the exchanges with their work partners. According to them, the social presence with the workgroup led to a greater sense of collaboration between them and resulted in a more intensive use of the target language.

The presence of team members was also mentioned as a driving force, which contributed to more than half of the learners in case study 2 putting more of their language repertoires into action. Around a quarter of these learners directly related this change to the integration of AR in the classroom.

The main difficulty that mitigated the overall degree of perception of this group related to immersion. Learners with unsatisfactory perceptions generally explained their rating with technical issues. For instance, the phone battery would not last a whole session, some smartphones did not have the AR option and a slow internet connection impeded interactivity and presence in some other cases.

Despite their overall satisfactory degree of perception, it should be noted, nonetheless, that the participants in case study 2 do not yet expect language teachers to systematically integrate AR as a teaching medium.

Whereas language learners had the most positive perception of AR (71,4%), only 31.3% of pre-service teachers (case study 1) reported to be satisfied with AR in the classroom. It is also noteworthy that the ratings of aspiring teachers were about halved between the first and second questionnaires (from 58,9 % to 31.3%). The arguments raised by this group to justify their degree of perception essentially related to their role as teachers.

A large majority of aspiring teachers had a poor user acceptance of AR, be it as user or developer. Even if they were offered a ready-to-use AR activity to carry out in the classroom, more than 9 out of 10 aspiring teachers claimed they would not feel confident in implementing the activity successfully. A similar proportion expressed the same concerns if they had to create an activity from A to Z.

In comparison to other tools, they have come to master, the participants of case study 1 also correlated AR with unreliability due to the dependence on the learner's device and an off-balance ratio between preparation time and use in the classroom.

More marginally, AR has been assimilated to a game and its use as a serious teaching medium has been ruled out.

The second research hypothesis put forward that the students' familiarity with other educational technologies represents a facilitating factor in their acceptance of AR.

Even if AR was overall perceived as innovative and/or enjoyable, participants of both case studies found it difficult to skilfully familiarize themselves with AR. From this point of view, the educational technologies traditionally used in the classroom did not seem to be a sufficient resource for the participants in the two case studies.

Users experienced technical difficulties in various forms. One of them related to the use of the personal smartphone. Several users expressed concerns regarding their data protection rights, which could be resolved by lending another device or using an app without registration. Other users required targeted technical help with their smartphones, as they did not know their way around the device. This issue was particularly documented among participants of case study 1, who repeatedly asserted that their digital skills were limited.

Because of the technology's novelty, the same participants also expressed doubts about the added value for language learning and teaching. Given the perceived difficulty of programming and tailoring even code-free apps and platforms for a specific teaching context, participants of case study 1 explicitly expressed their reluctance to engage with AR.

Discussion

AR's versatility has let to its early adoption and high regard, notably, in STEM education (Iqbal et al., 2022: 5-6; Lampropoulos et al., 2022: 3). As pointed out in Marín-Díaz' study (2017) however, the use of AR in education, whether STEM or else, appears uncommon; even in an educational setting in favour of digitalization like Luxembourg.

The infrequent use of AR should not be interpreted as a lack of effectiveness. From the strict point of view of the learners, AR's use in the language classroom is widely seen favourably. This finding is consistent with previous research[vii], describing AR as portable and adaptable, enjoyable and problem-based, realistic and situated, risk-free and experiential[viii], autonomous and collaborative, interactive and innovative (e.g., Arneton et al., 2022: 74; Elmeziane & Lecorre, 2021: 2-3; Hein et al., 2021: 118-131; Iqbal et al., 2022: 2-23; Lampropoulos et al., 2022: 3; Punar Özçelik et al., 2022: 131-144). These features induce a result-oriented approach, which reinforces the learner's role as an actor (Iqbal et al., 2022: 22-23; Punar Özçelik et al., 2022: 133).

Yet, regardless of these advantages, the digital uses developed from other educational technologies do not seem to be transferable to the new digital uses required by AR. Among pre-service teachers, this extra effort required to master AR is reflected in the perception that AR is an inappropriate, i.e., ineffective teaching medium. This result should nonetheless be seen in the context of a broader need for training in digital pedagogy focussing on AR, as emphasised by Belda-Medina & Calvo-Ferrer (2022).

AR being an educational technology "that is still in its infancy", users/learners and developers/teachers could only seize limited opportunities to test and to train to set up AR activities (Belda-Medina & Calvo-Ferrer, 2022: 12124). The newness of AR consequently potentially entails a lack of digital literacy from both AR users and developers on

one hand (Hein et al., 2021: 128; Punar Özçelik et al., 2022: 146) and a sensitivity to the novelty effect on the other hand (Elmeziane & Lecorre, 2021: 16; Hein et al., 2021: 128). This novelty effect may distract the learners from the task at hand, hence impairing the effectiveness usually associated with immersive technology (e.g., Ali, 2022; Chen & Wang, 2018).

Even if the overreliance of AR on the smartphone, with consequences in terms of immersion and user experience, cannot be addressed easily (Iqbal et al., 2022: 23; Punar Özçelik et al., 2022: 134; Wu, 2022: 165), the maturation of immersive technologies should lead to the development of new, more flexible, and interactive apps and platforms, with a greater focus towards the education sector (Belda-Medina & Calvo-Ferrer, 2022: 12138; Wang, 2017 : 165). In the meantime, as far as teaching practices are concerned, the initial approach to an educational activity involving AR should be further marked out. Prior to the in-class activity, teachers engaging with AR could find out about the hardware of the equipment available to the students in their class. As not all apps and platforms are necessarily compatible with both iOS and Android, this step would be useful to help choose the app or platform on which the AR activity could be used, if it relies on existing apps, or developed, if it is designed independently. In a second stage, during class, an introduction to AR as a technology could be provided before the actual teaching activity begins. These steps would make it possible to mitigate at least some technical difficulties, which are the main sources of dissatisfaction observed among the participants of our case studies.

Although the main limitation of this multiple case study is the small number of participants, it provides results that are consistent with existing research. Future work should therefore expand the sample size and share new insights regarding the perception of AR in an educational setting where digital technology is largely promoted. Determining whether AR can effectively be a key enabler of multilingual didactics is yet another axis of research.

Conclusion

The new socio-political transformations brought by globalisation are intricately intertwined with technological and informational mutations (Wu, 2022: 163). Hence, alongside globalisation, there is a global trend towards the digitalisation of society, initiating a new age known as the digital era.

This digital era is pervasive and has been affecting a growing number of sectors. Because of this digital era, the education sector has opened to the use of technologies, some of which have since become obsolete, while new ones have taken their place (Karsenti, 2004). Augmented Reality (AR) fall into the latter category. Following the rise of the smartphone, AR, which were previously the privilege of equipped laboratories, has made its way into the classroom.

In practice, however, the novelty of AR is more of a disadvantage than an advantage. This novelty means that language learners and their teachers are confronted with a technology that bears very little resemblance[ix] to those they are accustomed to using or have already mastered. Especially from the point of view of the aspiring teachers of our first case study, this lack of familiarity and the effort it takes to learn how to use the technology itself, lead to poor user acceptance with AR and therefore to a rather negative overall perception of the tool.

Although the integration of AR is therefore not always seen as straightforward, it has been widely described as an innovation that should be promoted and supported for its pedagogical advantages and its ability to "facilitate the creation of inclusive learning experiences", an obvious asset in a globalized heterogeneous classroom (Lampropoulos et al., 2022: 30).

This more positive perception of AR is most prominent among the language learners from our second case study. Unconcerned with questions of preparation and pedagogical planning, these users perceive the experimental side of AR more clearly, discover a tool “which can be claimed as magic” (Punar Özçelik et al., 2022: 131), and thus enjoy to a greater extent (even though through trial and error) the learning experience and interactivity offered by this new technology.

User acceptance is a crucial challenge for future technologies, like AR (Iqbal et al., 2022: 23). Due to its influence on the degree of perception, poor user acceptance, esp. negative “psychological responses of learners to AR environments”, could successively impede the degree of presence and affect the learning outcomes (Chen & Wang,

2018: 706). Such inefficiency is surely the last scenario teachers would wish to see, as they experiment “to modify their strategies and diversify their teaching tools” in an increasingly globalized classroom (Ali, 2022: 17).

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Endnotes

[i] In 2022, Luxembourg was home to more than 170 nationalities, making 47% of the population foreign (Laurent & Doré, 2022: 3). Likely due to this trend, during the same period, about 6 out of 10 pupils in secondary school did not speak Luxembourgish as their first language at home (MENJE, 2022: 2). At the University of Luxembourg, 54% of the student population and 80% of the staff were reported to have an international background (University of Luxembourg, 2022: 3).

[ii] Luxembourg is peculiar in that its communities are *de facto* plurilingual. This is due not only to its social history, but also to its three official languages (French, German and Luxembourgish), which are not used on a geographical basis, but according to the topics under discussion (Garcia, 2014). At the University of Luxembourg, this multilingualism has been transposed into internal rules, making French, English, German and, to a lesser extent, Luxembourgish, the teaching languages of the university. As a result, programs offered at the university commonly require language skills in two (or more) languages (Lejot, 2015).

[iii] Please note that "while in the field of [Human-Computer Interaction], clear definitions of immersion and presence exist, including theories, measures, and a large corpus of empirical results. In the field of education, immersive technologies are used without such a clear definition and theoretical base." (Hein et al., 2021: 125).

[iv] Immersive technologies are also referred to as *eXtended Reality* (XR) (Hein et al., 2021: 118).

[v] In AR, by contrast to VR, just being connected to the activity does not guarantee learner presence. Chen & Wang (2018: 698) identify three types of presence: physical, social, and temporal.

[vi] Immersion and presence are described as "so-called hygiene factors" (e.g., Hein et al., 2021: 119).

[vii] Although it is debated (Marín-Díaz, 2017), AR technology is also characterized as inclusive (Lampropoulos et al., 2022: 3).

[viii] An experiential mode of learning is defined as a "a learning model that advocates participating in activities in contexts that are as close as possible to the knowledge to be acquired, the skills to be developed and the attitudes to be formed or changed (Legendre, 2007)." (Béchard, 2012) (Translated from French: "L'apprentissage expérientiel est un modèle d'apprentissage préconisant la participation à des activités se situant dans des contextes les plus rapprochés possibles des connaissances à acquérir, des habiletés à développer et des attitudes à former ou à changer (Legendre, 2007). »)

[ix] Most users generally already know how to scan QR codes (in the case of a vision-based marker-based AR activity).