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Augmentation of Language Learning: Exploring AR Design Frameworks and Principles for Technology – Driven English Language Education

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Abstract: Mobile Assisted and Computer Assisted language learning got them accepted as mainstream of applications in English as a Second language acquisition across the globe from past decades. Advancements in mobile technologies encouraged Augmented Reality (AR) supporting learning as a cutting-edge aspect in Mobile Assisted Language Learning (MALL). In order to verify the effectiveness of diverse mobile technologies and AR products, previous studies rely on case study approach. They do often lack in strong theoretical support like frame work and design of modes. This paper reviews and gives crisp information of various language mainstream language learning theories in English language learning and examines recent studies of Augmented Reality in English Language Education (ELE). Later, introduction of three existing AR designed frameworks in the context of mobile learning and aiming to design theoretical insights into learning and designing technology driven language learning tasks. Few design and learning principles for language teachers also been specified in order to promote integration of Augmented Reality (AR) in English Language education.

Key Words: Augmented Reality, Learning Theories, Language Learning, Mobile technologies

Introduction

Augmented reality (AR) is becoming increasingly prevalent in our personal lives through various forms such as mobile games (e.g., Pokémon GO), TV dramas (e.g., Memories of the Alhambra), professional skill training, Global Positioning System (GPS), and more. In this chapter, the definition of AR proposed by Wang and her colleagues (2018) is adopted, which involves "a combination of technologies that superimposes computer-generated content over a real word environment" (Wang et al. 2018, p. 1391), and connects the real and virtual worlds interactively in three dimensions (Azuma, 1997).

Mobile-assisted language learning (MALL) has rapidly developed in current era due to the advancements in new technologies and use of smart phones in a wider range. Empirical research has been conducted on MALL, and educators and researchers have promoted these use of mobile apps in English Language Education (ELE), like quick message apps and self-developed learning software.

Among which AR software is used as one types of mobile learning tool, and AR in ELE is a sub category and comes into the scope of MALL, which can enable continuity and can make spontaneous while the interaction takes place across various language teaching and learning elements.
However, there is a lack of reports exploring AR in language education, specially in the area of teaching and learning English, and many MALL researchers lack theoretical support. Therefore, it is necessary to make an observation at various relevant language learning theories and practices which are suitable for supporting AR-based learning before integrating AR technology into language teaching and learning on a large scale. In order to clarify the information the current paper offers suggestions on improvement of instructors' preparedness adopting various new technologies in language teaching and to facilitate various theoretical guidance for future research in the area of Augmented Reality(AR). It reviews several well-known and popularly adopted language learning theories, showcases illustrative case studies in the area of ELE contexts, the paper also proposes various learning principles and instructional designs for English language teachers based on existing AR designs and frameworks.

AR based Mobile app – One of the English learning material

Constructivists believe that learning is an active and dynamic process, where learners use their previous knowledge and experiences to construct their own perspectives (Bruner, 1996; Dewey 1916; Jonassen, 1991; Piaget, 1973). This theory emphasizes the importance of learners' diversity and active engagement in learning practices (Dewey 1916; Aljohani 2017; Kaufman 2004). Many contemporary learning theories, such as discovery-based learning, situated learning, and problem-based learning, are rooted in constructivism, and AR-supported learning also aligns with its essence (Wang et al. 2018). Liu and Tsai (2013) designed AR-based mobile apps which provide English learning materials based on the constructivist theory to aid college EFL learners in writing English compositions.

In their study, Liu and Tsai (2013) invited a group of five undergraduate English majors to take a campus trip using AR-based mobile learning materials on their smart phones. Using GPS and AR techniques, learners were situated in the real environment and obtained knowledge generated by the AR technique. Learners could access information about predefined locations by directing their camera towards them. After the trip, they wrote a composition and completed a questionnaire. The study demonstrated students' progress in grasping linguistic and content knowledge and enhanced their knowledge of the campus. Learners reported the advantages of this type of material in helping them familiarize themselves with the campus scenic spots and expand their vocabulary repertoire. However, learners faced challenges due to their lack of digital literacy skills.

Place-based language learning practice facilitated by AR-based mobile technology can motivate learners to actively engage in language learning activities (Godwin-Jones 2016; Lee 2012). Scholars have attempted to conduct AR-enhanced place-based language learning research to improve different language skills, including speaking abilities, vocabulary knowledge, and intercultural and communication skills (Boonbrahm et al. 2015; Santos et al. 2016; Liu et al. 2016). Although constructivism has become one of the most supported approaches in language learning, social constructivism, which emphasizes the importance of social interaction and collaboration, is not reflected

in these studies. Therefore, in the next section, the importance of social and cultural factors in mediating students' language learning experience will be highlighted using an example under the guidance of social constructivism and sociocultural theory (SCT).

Socio-Cultural Theory in Language: A place based AR Game to practice language learning

Language educators and researchers widely recognize the significance of social and cultural factors in language acquisition. Sociocultural theory (SCT) in language education has become increasingly popular in recent years. Lantolf and Thorne's seminal work provides educators and researchers with valuable insights into the development of human language from a psychological perspective. The recent definition of SCT by Lantolf et al. describes SCT as a theory of mind that acknowledges "human mental functioning is fundamentally a mediated process that is organized by cultural artifacts, activities, and concepts." This chapter briefly discusses two key constructs of SCT, namely mediation and Zone of Proximal Development (ZPD), in relation to AR.

Vygotsky believed that human mental development is impacted by the "culturally constructed auxiliary means" that includes cultural artifacts, activities, and concepts. To accomplish learning tasks, social interactions and mediation are of prime importance. As Lantolf and Thorne believe, cognitive development benefits from "a dialogically produced interpsychological process through which learners internalize knowledge." This idea reflects the second construct in this section, namely ZPD.

AR place-based technology, such as mobile games, has benefits in extending learning beyond physical environments, creating opportunities for collaborative learning and providing contextual information for learners. These affordances are in line with the mediation and ZPD concepts in SCT, in that learning is mediated by AR technology and placed in a contextualized setting, and place-based AR games usually require a group of team players to participate.

In Portland State University, Thorne et al. conducted a research project to investigate how a project-based AR game (ChronoOps) facilitated learners' English language proficiencies. As an exploratory study, Thorne et al. found that the use of AR technology and the coordination among social, physical, and informational surroundings mediated/facilitated the entire learning process. In language learning, speaking serves as a constructive activity for learners to outwardly and inwardly regulate thinking and behavior. Outwardly speaking, a speaker can regulate other people's behavior via linguistic or non-linguistic signs such as directing students' attention to a certain piece of information. Inwardly speaking, linguistic artifacts provide affordances in regulating individuals' behavior and thinking. Overall, learners' learning was co-constructed among peers as well as mediated by their cultural artifacts (e.g., (verbal/non-verbal) language and AR games), physical environments, and cultural concepts, which in turn augmented learners' learning processes.

AR Enhanced ubiquitous learning environment in English language learning

The traditional learning theories, including behaviorism, cognitivism, constructivism, and SCT, were developed before the digital age. However, Siemens (2005) argues that learning can occur in non-human appliances that connect various information sources. Connectivism, as a successor of the previous theories and an evolution of pedagogical paradigms in the digital era, guides the development and implementation of new technologies, such as augmented reality (AR) (Greenwood and Wang, 2018; Wang et al., 2018). Connectivism in technology-enhanced learning emphasizes that technologies create new learning opportunities for learners to access, acquire, and share knowledge, which promotes interactive and collaborative learning within seamless networked learning contexts. In a networked world, individuals need to improve their ability to access information and make connections with other individuals, groups, systems resources, and communities (Bell, 2009).

Mobile technologies enable learners to instantly access various learning resources beyond the limitation of time and place (Pachler et al., 2010). AR technology extends these possibilities, offering learners more exposure to a combined actual and virtual language learning environment. For instance, Liu (2009) developed an AR-based context-aware ubiquitous learning environment called Handheld English Language Learning Organization (HELLO) to enhance English as a foreign language (EFL) learners' speaking and listening skills. HELLO combines conventional technologies such as sensors and ubiquitous computing with emerging technologies such as AR to create a contextualized English learning environment. In HELLO, teachers control the management system, and students access all the learning materials via a PDA phone. They can talk to the virtual tutor, take tests, and obtain new information by taking pictures of the 2-D bar code attached in a specific location.

Liu's (2009) case study aimed to leverage the potentials of HELLO to enhance students' communicative abilities, such as listening and speaking skills. The eight-week course involved three main study phrases: (1) "Campus Environment" - a self-study phrase, (2) "Campus Life" - a context-aware immersive learning activity phrase, and (3) "Campus Story" - a task-based collaborative learning activity phrase. The experimental group performed significantly better than the control group in all the learning tasks, demonstrating the effectiveness of using HELLO in improving their communicative skills. Most participants showed positive attitudes toward HELLO, agreeing that such an AR-based context-aware ubiquitous learning environment could not only benefit their new linguistic knowledge acquisition but also motivate them to continue developing their communicative competence in the future.

In summary, connectivism in technology-enhanced learning emphasizes the importance of technologies in creating new learning opportunities for learners to access, acquire, and share knowledge in seamless networked learning contexts. AR technology extends the possibilities of mobile learning, and Liu's (2009) case study exemplifies an AR-based context-aware ubiquitous learning environment that offers students richer learning experiences by providing multiple types of learning materials, helping them establish connections between the physical and virtual world, and practice language skills. However, more pedagogical efforts are needed to overcome the constraints of devices and technology, help

students become more familiar with emerging technologies, and work with school teachers to assess the practicality of such environments in satisfying students' various learning needs.

Existed AR Designed frame works to learn English Language

This section aims to analyze three existing AR design frameworks from different perspectives: learner, designer, and technology, to provide a theoretical foundation for implementing AR in ELE. The three case studies presented in the previous line are used to assess the advantages and limitations of AR products and generate pedagogical principles for educators and language teachers.

In 2012, Novak, Wang, and Callaghan proposed a four-circle model for designing mobile-AR curation activities in art and science museums. The model, guides students through a process of theme development to help them select artifacts and resources, understand them, identify relationships between them, and synthesize their understanding in meaningful and organized ways. Peer interactions and discussions are also encouraged to consider the socio-cultural context surrounding the learners. This model is learner-centered and promotes learner autonomy during the learning process, which could also be beneficial for language learning activities. However, to further encourage active participation in both learning and designing stages and to contribute instructional materials, more effort is needed in AR-based context-aware ubiquitous learning environments.

To enhance language learning through Augmented Reality (AR) technologies, learners should be encouraged to actively engage with the technology, such as encoding language learning materials into QR codes and placing them in specific locations (Novak et al., 2012). When considering AR in the context of mobile learning, it is important to understand the unique strategies of mobile learning environments. Xiao et al. (2011) developed the LTCS model, which was later expanded upon by Machun et al. (2012) to include Design as a factor, resulting in the LTCSD model. The mobilegogy model still applies to English Language Education (ELE), but improvements are needed in Technology and Design, and more effort is required to address cultural barriers. Future design should also strive to position learners in real language learning settings, incorporate more elements of Satisfaction, and focus on creating an interactive, collaborative, and learner-centered AR-enhanced language learning environment. The SAMR model, originally proposed by Puentedura (2006), can guide educators in evaluating the transformative potential of mobile learning activities, particularly in the context of ELE.

Puentedura (2006) and Hockly (2013) suggest that Substitution is the most straightforward method of integrating technology, including mobile technology, into the learning process. However, at this stage, learning activities could still be completed without the use of technology. Progressing beyond Substitution, technology can offer functional improvements, not just substitute traditional approaches, as seen in the Augmentation level. Puentedura (2013) argues that while learning activities at the Substitution and Augmentation levels can enhance learning, the Modification and Redefinition levels can transform it. Redesigning learning activities falls under the Modification level, while at the Redefinition level, technology-enhanced language learning tasks are unique and impossible to complete without technology support.

Currently, mobile learning implementation still involves learning activities at the Substitution and/or Augmentation levels. Nevertheless, many practices exceed these levels, offering learners greater benefits at the higher levels. The three AR-enhanced cases examined in Sect. 12.2 fall under the Redefinition level, providing language learners with a connected, situated, and personalized learning experience (Romrell et al., 2014). For example, Liu and Tsai's (2013) study demonstrated the effectiveness of using mobile AR technologies to redefine language learning. With the assistance of GPS and AR technologies, learners in their study were connected to new knowledge, situated in real-life language learning contexts, and acquired new knowledge in a personalized way. Traditional teaching and learning approaches could not have created such an innovative experience for learners.

These three existing frameworks offer theoretical insights into designing, implementing, and evaluating AR-based language learning activities. Current AR practices have surpassed those driven by other technologies (e.g., mobile-based SMS delivery), falling into the Redefinition level of the SAMR model. However, there is still a long way to go in creating more learner-centered, interactive, and collaborative language learning environments for our learners. In the next section, we will present pedagogical principles to help language instructors and students better position themselves in AR-enhanced language learning settings and effectively learn a foreign language.
According to Ellis (2010) and Lantolf and Poehner (2014), a good learning theory should provide insights that inform teaching practice, and the relationship between theory and practice should be reciprocal. The ecology model presented in Figure 12.4 is based on these learning theories, design frameworks, and case studies, and it describes the relationship among the teacher, designer, AR technology, and learner community in both formal and informal learning settings.

On the left side of the model, the teacher and designer collaborate to understand user needs and the capabilities of AR technology to design immersive learning experiences for their students. On the right side of the model, individual learners can communicate and collaborate using AR technology and provide feedback to the teacher and designer, who can then revise the learning activities. This ecology model aligns with the design thinking model and its five key steps (empathize, define, ideate, prototype, and test) that have been widely used in designing user-centered and innovative learning solutions.

To further develop this ecology model, we provide step-by-step pedagogic and learning design principles that can be derived from the model.

Identification of gaps and needs of English Language Learners and to design proper based environment

To better cater to the diverse learning needs of students, language instructors should adopt a facilitator, supporter, and guide role, which involves identifying learners' language learning needs and knowledge gaps. This requires instructors to analyze the underlying issues and reasons behind students' difficulties. Additionally, before developing AR-enhanced language learning materials, designers should collaborate with instructors to identify key problems and constraints, such as learners' data and assessment information and technological limitations. Key capabilities that need to be focused on should also be determined. In the interactive and collaborative AR-enhanced language learning environment, learners should be encouraged to share their opinions and participate in discussions using synchronous and asynchronous forums and social networking sites, as depicted in the ecology model. Instructors and

designers should actively work together to synthesize learners' responses to identify core problems and goals.

To encourage creativity and generate ideas in the AR-enhanced language learning environment, instructors can facilitate brainstorming sessions on synchronous and asynchronous discussion forums and social networking sites. Collaborative activities can be designed to allow groups of learners to present their prototypes to the whole class and receive feedback and suggestions for improvement from other groups.

Instructors should take on the dual role of language teacher and AR technology designer to better understand their students' needs and customize the technology for their teaching. However, familiarity with AR technology and its affordances and limitations is essential before getting involved in the designing process.

As learning has become more autonomous and student-oriented in the digital age, teachers should acknowledge the role of the internet in facilitating learning in an unstructured learning environment. The AR-enhanced language learning environment should empower learners in the holistic language learning process by providing access to various online resources. By designing and implementing interactive and collaborative language learning activities, learners are encouraged to connect with others, express opinions, share ideas, and construct meaning. More importantly, learners should be empowered in decision-making, being able to efficiently search for, critically evaluate, and creatively use information from the physical and virtual layers of the AR-based materials to develop their knowledge system.

Conclusion

English fever has become a reality in many EFL countries and regions, and educators are leveraging technology to enhance students' language learning experiences. AR technology, in particular, has gained attention for promoting learner-oriented language learning, creating interactive and collaborative environments, increasing motivation, and facilitating language learning outcomes.

The chapter begins by introducing the concept and features of AR technology and discussing three key learning theories: constructivism, sociocultural theory, and connectivism. Recent case studies in ELE are presented to illustrate these theories. Three existing frameworks are then introduced to provide theoretical insights for future AR-enhanced language learning design and development. Finally, an ecology of AR-enhanced language learning is provided for educators to better use AR technology in practice. As AR technology continues to advance, we can expect to see more AR-based language learning products that enhance the reality of English language learning. Researchers, instructors, and practitioners should strive to understand the essence and emphases of different learning theories to optimize future academic research and pedagogical practice in English Language Education.

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