Critical Immersive-Triggered Literacy in Inclusive Digital Education

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The critical immersive-triggered (CIT) literacy, which allows for the internalization of cognitive skills through attention-drawing multisensory functionalities on specific learning objects. In the Metaverse era, the incorporation of activities that lead to CIT literacy can facilitate digital attention in the learning process and lead to the synthesis and creation of new content.

immersive technologies | critical immersive-triggered literacy | MAR | language learning

1. Educational Technology and AR in Education

According to [1], there are some factors that teachers and students consider when designing or implementing novel AR learning activities and environments, namely (a) accessibility, meaning the availability of devices that support the AR app operability for the whole classroom; (b) technology evolution, focusing on what can actually be used in the classroom, as some AR apps are still in the development stages and bugs are still being fixed; (c) space requirements, for cases where open or large spaces are required for the AR content to be projected from different angles; (d) teacher support, ranging from digital skills and need for guidelines and training to school's administration and IT department support for solving technical issues with the school firewall blocking the applications; (e) suitability to audience and goals, with a purposeful selection of apps that suit the students' needs, curriculum and teaching goals; (f) pedagogical approaches, considering how to pair AR experiences with other instructional practices for meaningful learning; and (g) contextualizing the content, focusing on how AR technology can support the learning goals.

Regarding teacher readiness, [2] posits that there is a need for teachers' professional development on technological pedagogical models, such as TPACK (technological pedagogical content knowledge), to promote student learning in a growing technological world and design and develop teaching and learning processes according to the needs of the students [3]. The author of [4] references the TPACK framework [5], outlining how content and pedagogy, namely how the teacher imparts that content, must form the foundation for any effective educational technology integration in order to enhance the students' learning experience. Specific technological tools (hardware, software, applications, and associated information literacy practices) should be utilized to instruct and guide students toward a more robust understanding of the subject matter. As such, Kurt suggests that in order for teachers to make effective use of educational technologies, educators should be open to certain key ideas, including (a) how concepts can be represented using technology; (b) how students' different skills level on the conceptualization of

content can be addressed; (c) how technologies can narrow the gap of diversity in background and prior knowledge; and (d) how to strengthen students' existing knowledge and help them acquire new knowledge.

Research conducted by the authors of [6] found that AR applications that presented vocabulary in the target language in a foreign language educational context with 3D image, sound, and movement allowed students to visualize the learning content, thus achieving a higher performance and enjoyment while learning. The researchers also point out the importance of content in using AR. They suggest that future should studies explore appropriate learning content to support and inform teachers so as to benefit from it while stressing the need for teacher training and guidelines for teachers to incorporate AR tools in the classroom [7][8].

The importance of teacher training and guidelines is also highlighted by [9]. The researchers present the "Augmented Reality Learning Analytics" (ARLEAN) ethical framework, tailored to the specific characteristics that AR applications have, and focused on various learning subjects with the intention of providing guidelines to instructional designers and educational technologists on the effective integration of immersive technologies in educational settings, thus optimizing learning outcomes. The researchers posit that the core of this framework blends the technological, pedagogical, and psychological elements that influence the outcome of educational interventions with the most widely adopted learning analytics techniques. As researchers in [10] note, most of the AR educational applications are one-off prototypes, which constitutes a practice that hinders the development of a mutual understanding regarding the common design elements and the effectiveness of these alternative educational practices.

Such practices, while providing the foundations to evaluate the strengths and limitations of AR educational interventions, deprive the researchers of the generalization of the outcomes as the sample sizes are small and the research is carried out in specific contexts and scientific fields. To this end, as [11] also contends, the evolution of a universal digital ecosystem where a large amount of data is utilized may better inform the research directions and the respective practices. In light of this, the authors suggest that contemporary education requires analytical thinking skills in conjunction with the use of an LMS, and that "the integration of AR technology can facilitate the simulation of real-world problems and support the deconstruction of the different concepts that govern these fields" (p. 5). Following this premise, the proposed framework and system offer them the means to undertake a simulated experience that complements the learning process and promotes in-depth knowledge development.

2. AR in the EFL Context

In the context of adolescent foreign language learners, MAR technologies enable learners to instantly access various learning resources [12]. The researchers of [13] designed an AR-based context-aware ubiquitous learning environment called Handheld English Language Learning Organization (HELLO), aiming at enhancing 7th-grade EFL learners' speaking and listening skills, with the intent of contextualizing English learning environment by combing conventional technologies (e.g., sensors and ubiquitous computing, information technologies) and emerging technologies in the connectivity era. The post-listening and speaking test scores suggest that the experimental group performed significantly better than the control group in all the learning tasks, improving their

communication skills. The participants' interviews showed positive attitudes toward the AR-based learning environment as it could not only benefit their new linguistic knowledge acquisition but also motivate them to continue developing their communicative competence in the future.

In 2014, the authors of [14] investigated learners' achievement, attitude, and cognitive load levels in the EFL context by utilizing an AR book created with the aid of marker-based technology. The materials were additionally supported by English pronunciation. The findings reveal that the cognitive load levels and anxiety of students are low when engaged in the process of self-directed learning in an AR-based learning context. The implementation phase was short (four sessions) and was carried out under the guidance of teachers in computer laboratories to ensure digital skills capability. In 2017, the authors of [15] also conducted a study focusing on the aspect of reading comprehension where augmented reality game-based learning was incorporated to create a sort of augmented 3D book to enrich students' learning experience. In this study, 51 students participated in the activity in pairs using a tablet which involved answering reading comprehension questions after exploring different scenes in a book where the AR application superimposed virtual imagery to illustrate certain aspects of the book. In this study, the students were found to show more enjoyment as compared to that achieved when solely reading from a book. An interesting thing to note was that for more "opinion"-based comprehension questions, students provided more informed, stronger, and longer answers as compared to the control group, which only read the book without the use of augmented reality.

In more recent studies, Ref. [16] conducted a survey with a mixed method, recruiting students that were split into experimental and focus groups to discuss the effect of AR applications on secondary school students' reading comprehension and learning permanency. The findings reveal that the experimental group students showed a higher level of reading comprehension and learning permanency. The students also reported that they experienced satisfaction from their participation in AR-based reading activities and low anxiety levels. Ref. [17] conducted a study based on the ARCS learning motivation theory [18], namely attention, relevance, confidence, and satisfaction, to support situational classroom learning and improve the performance and foreign language learning effectiveness with the use of augmented reality. The English learning scenario was supported by the HD Reveal Aurasma platform and app with the intention of enhancing language input and output with airport situation-related conversation themes. The experimental results, as in previous studies, revealed that the real-life AR scenarios enhanced student confidence in learning English and improved learner satisfaction.

Nevertheless, to date, studies in the EFL context that leverage AR technologies focus on a short-term implementation period, in specific educational settings, with students that bear homogeneous socio-cultural attitudes. Additionally, the evaluation of their use in an educational setting does not present a theoretical framework that supports the pedagogical decisions made. This might be reflected the educators' and researchers' focus on the kind of novelty to be used in the classroom, incorporating and evaluating the AR interventions instead of focusing on how its affordances are aligned with the pedagogical decisions made [19][20].

The researchers [19] also note that in a systematic review conducted between 2014 and 2019, the incorporation of AR interventions in the EFL context focused on specific language skills. More specifically, they found that among

the skills that have been investigated concerning the application of AR technology in language learning, vocabulary represents the most investigated topic area (23.9%), followed by reading (12.7%), speaking (9.9%) and writing (8.5%), whilst a substantial number of manuscripts focused on generic language skills (9.9%); however, communication building skills are still at an early stage in AR surveys. To this end, the authors employed the KSAVE (Knowledge, Skills, Attitudes, Values, Ethics) 21st century skills framework proposed by [21] with four dimensions and 10 categories of skill building, as follows:

- *ways of thinking*, regarding (i) creativity and innovation, (ii) critical thinking, problem-solving, and decision-making, and (iii) learning to learn and metacognition;
- *ways of working*, with communication and collaboration (teamwork) skills' building;
- *tools for working*, focusing on ICT and information literacy, which includes research on sources, evidence, bias, etc.;
- *living in the world*, with a focus on citizenship, life and career, and personal and social responsibility including cultural awareness and competence.

Additionally, AR-based collaborative learning and social interaction in the EFL context in the digitally connected world have not been examined on a broad scale. According to the global education monitoring report 2020 [22] and the UNESCO 2030 Agenda [23] for sustainable development, inclusive education systems should focus on creating more inclusive and equitable societies, ensuring that 'all means all' and 'no one is left behind'; thus, coupled with the need of the contemporary learner for interaction in a digitally connected multicultural context, further research on this topic is needed.

3. Critical Digital Awareness in Education

Digital literacy is not only essential to explore, participate in, and benefit from digital opportunities in today's global connectivity age, but also to ensure an awareness of exposure to risks and threats in everyday digital environments related to personal data and privacy protection [24]. Ref. [25] stresses the importance of incorporating media literacy in school curricula as a component of security competence, critical media consumption, and well-being. As [26] notes, despite broad claims that current students are digital natives, technology skills are not universal among all young children [27]. In 2011, in response to the ever-evolving need for educational innovation in the digital era, UNESCO created a curriculum to enable the educational community to better understand the role of media. It focused on the acquisition of media literacy as "a set of essential competencies (knowledge, skills, and attitudes) that allow citizens to engage with media and other information providers effectively and develop critical-thinking and lifelong-learning skills for socializing and becoming active citizens" [28] (p. 187). As [29] notes, students may be resistant to the process of interrogating and examining their media literacy practices; as such, it is the media literacy educators' responsibility to shift their interest from students' "tool competence"—that is, their ability to use sophisticated technology—to "digital citizenship", a concept closely related to media literacy that focuses not

only on the necessity of internet safety but also on the rights and responsibilities of students as communicators on the internet and in real life.

As [30] notes, building these skills moves “audiences from awareness to action, from passivity to engagement, from denial to acceptance of responsibility for what each of us can do… as participants in our media-dominated society” (p. 275). The European Commission Report [31] suggests that one of the main curriculum approaches to digital competences’ building in primary and secondary education is “[a]s a cross-curricular theme: digital competences are understood to be transversal and are therefore taught across all subjects in the curriculum. All teachers share the responsibility for developing digital competences” (p. 28). Thus, it is essential that educators cultivate youths’ digital literacy to help them to effectively and creatively use existing ICT in our technology-driven society [32]. The need for media literacy educational practices and lifelong media literacy development raises the issue of teachers’ preparedness to introduce media literacy classes into secondary and high school curricula. In addition, there is a need for the development of new forms, models, and teaching methods to implement media educational innovations.

4. AR for Collaboration, Communication, and Social Skills

In a recent study, Ref. [26] identified some obstacles during the implementation of their survey on social-constructivism mixed-group learning with AR, namely (a) language barriers, (b) online privacy concerns, (c) a lack of private virtual space for groups, and (d) limited opportunities for students to practice digital ethics and responsibility. Participants’ language barriers and low-performance skills, along with pre-existing digital skills, were identified as factors to pre-assess and be considered in a future design to customize learners’ experiences accordingly. Additionally, the study’s results revealed the importance of the design involving the contextual representation feature of AR as a crucial contributing factor to students’ development of digital literacy practices. The researchers stated that “to enable contextual representation with AR technology in the individual and group AR artifacts, students creatively used different digital tools to communicate and share with audiences their understanding and personal connection with a particular object or place” (p. 1428).

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