Integrating augmented reality and problem-based learning into English language teaching through instructional design

Integrando realidade aumentada e aprendizagem baseada em problemas no ensino de língua inglesa por meio do *design* instrucional

Integrando la realidad aumentada y el aprendizaje basado en problemas en la enseñanza de inglés a través del diseño instruccional

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ABSTRACT

This article aims at discussing how ADDIE, a systematic instructional design approach, can be used to integrate augmented reality technology and Problem-Based Learning pedagogy into English language classrooms. We present a brief retrospective view of the Brazilian English language teaching scenarios to which our proposal is addressed. Afterwards, we provide definitions to ADDIE approach, Problem-Based Learning and augmented reality into the context of English language teaching with technologies. We also propose the integration of the foregoing approaches through practical examples. Our discussion envisions possible impacts of appropriating augmented reality in language teaching classrooms, especially considering the particularities of a continental-scale country as Brazil during the paradoxical times we live in.
Key words: ADDIE approach. Augmented reality. Problem-Based Learning. English language teaching.

RESUMO

Este artigo tem como objetivo discutir como ADDIE, uma abordagem sistemática de design instrucional, pode ser usada para integrar a tecnologia de realidade aumentada e a pedagogia da aprendizagem baseada em problemas em salas de aula de língua inglesa. Apresentamos uma breve retrospectiva dos cenários de ensino da Língua Inglesa no Brasil aos quais se dirige nossa proposta. Posteriormente, fornecemos definições para a abordagem ADDIE, Aprendizagem Baseada em Problemas e realidade aumentada no contexto do ensino de inglês com tecnologias. Também

propomos a integração das referidas abordagens por meio de exemplos práticos. Nossa discussão vislumbra os possíveis impactos da apropriação da realidade aumentada nas salas de aula do ensino de línguas, especialmente considerando as particularidades de um país de escala continental, como o Brasil, nos tempos paradoxais em que vivemos.

Palavras-chave: Abordagem ADDIE. Realidade aumentada. Aprendizagem baseada em problemas. Ensino de inglês.

RESUMEN

Este artículo tiene como objetivo discutir cómo ADDIE, un enfoque sistemático para el diseño instruccional se puede utilizar para integrar la tecnología de realidad aumentada y la pedagogía del aprendizaje basado en problemas en las aulas de inglés. Presentamos una breve retrospectiva de los escenarios de enseñanza del inglés en Brasil a los que se dirige nuestra propuesta. Posteriormente, proporcionamos definiciones para el enfoque ADDIE, el aprendizaje basado en problemas y la realidad aumentada en el contexto de la enseñanza del inglés con tecnologías. También proponemos la integración de estos enfoques a través de ejemplos prácticos. Nuestra discusión vislumbra los posibles impactos de la apropiación de la realidad aumentada en las aulas de enseñanza de idiomas, especialmente considerando las particularidades de un país de escala continental como Brasil en los tiempos paradójicos en los que vivimos.

Palabras-clave: Enfoque ADDIE. Realidad aumentada. Aprendizaje basado en problemas. Enseñanza del inglés.

INTRODUCTION

The teaching of modern languages in Brazil has been a historically neglected area, especially when it comes to English (Celani & Collins, 2003). Despite substantial efforts of educational laws (Brasil, 1996) and curricula guidelines (Brasil, 1998, 2006, 2017) to help students develop useable knowledge of English, the focus on translations along with excessive prescriptive grammatical rules are still the most popular practices (Bernardo, 2019). Those methods seem to be driven by unfavorable conditions for teaching, i.e., limited workload, overcrowded classrooms that prevent teachers from properly guiding students during speaking activities, precarious pre-service teacher education, a shortage of in-service education programs, and low teacher salaries (Celani, 2003; Cox & Assis Peterson, 2008; Pessoa & Pinto, 2013; Menezes de Souza & Monte Mór, 2019). A general sense of failure both in public and private schools challenge researchers to deepen their understanding of such a complex scenario that is not unique to Brazil – it is actually lined up with a great number of teaching contexts around the world (Weddell, 2011; Freeman et al., 2015).

Students' making sense of what is being taught plays an important role with regard to overcoming the historical intricacies of English Language Teaching (ELT). Thus, providing real environments hinged on our students' current interests should be taken into account so that language could be learned as a social practice. As far as ubiquitous communication is concerned as well as the fact that 98% of Brazilians own cellular phones (Cetic.BR, 2020), digital technologies can help English teachers to provide cutting-edge social practices of language through countless resources, namely videogames, virtual and augmented realities, social media, applications for designing quality digital products, collaborative writing, search engines, instant messengers, streaming platforms, cloud storage and editing platforms, online dictionaries, language corpora, applications for language learning, and so forth (Gee, 2013; Paiva, 2019). Even if students' smartphones are not top-of-the-line, low cost advanced technology, such as augmented reality (AR), may be a viable option for promoting interaction and add virtual objects into real-world physical spaces.

AR, which might be familiar through the example of games as *Pokémon Go* (Bonner & Reinders, 2018), is defined as a system that combines and aligns real and virtual objects that coexist

at the same space and time in the world (Sorte, 2021). It may be understood as a complementary system to the real world by adding virtual components – sounds, images, and videos – to real objects, enriching the experience with that environment and/or object through mobile devices, such as smartphones and tablets (Azuma, 2001; Kirner & Kirner, 2011; Lopes et al., 2019). Therefore, AR can contribute to the teaching and learning of subjects in various knowledge areas, especially the English language, given its wide scope of development. In Brazil, according to Paiva (2019, p. 18), "we have not yet appropriated augmented reality for language teaching". And that is why we gear our attention towards this type of technology in this article.

In order that AR to be applied into ELT, learned-centered pedagogies need to be introduced at a micro level of teaching. Problem-Based Learning (PBL) in language classrooms, for example, allows students to experience complexities, ambiguities and uncertainties in daily relationships. According to Braga (2013), students may have opportunities to negotiate senses and meanings through interaction using digital technologies. Learning how to manage uncertainty in and because of the advanced technology is a key issue, because whether we like it or not, changes in society have been happening rapidly.

On the other hand, we also need to consider the macro level of implementing AR into ELT. A systematic instructional design approach would help teachers to integrate AR and learner-centered pedagogies, just as PBL, because teachers can be prepared to identify students' performance gaps and systematically work on them, especially in a context where a persistent focus on structure prevents students from making sense of English language as a social practice. ADDIE approach to instructional design (*A*nalyze, *D*esign, *D*evelop, *I*mplement and *E*valuate) "facilitates complexities of intentional learning environments by responding to multiple situations, interactions within contexts, and interactions between contexts" (Branch, 2009, p.1). Given the complex sense of failure in ELT aforementioned, ADDIE might be a valid choice considering the fact that it represents a product development paradigm rather than a fixed model *per se*. Given the various scenarios that encompasses the teaching of English language around the globe, adaptive approaches, such as ADDIE, can be a reasonable choice.

The purpose of this article[1] is to discuss how ADDIE, a systematic instructional design approach, can be used to integrate AR technology and PBL pedagogy into English language classrooms, as shown in figure 1:

Figure 1 - Structure of AR-based English language teaching
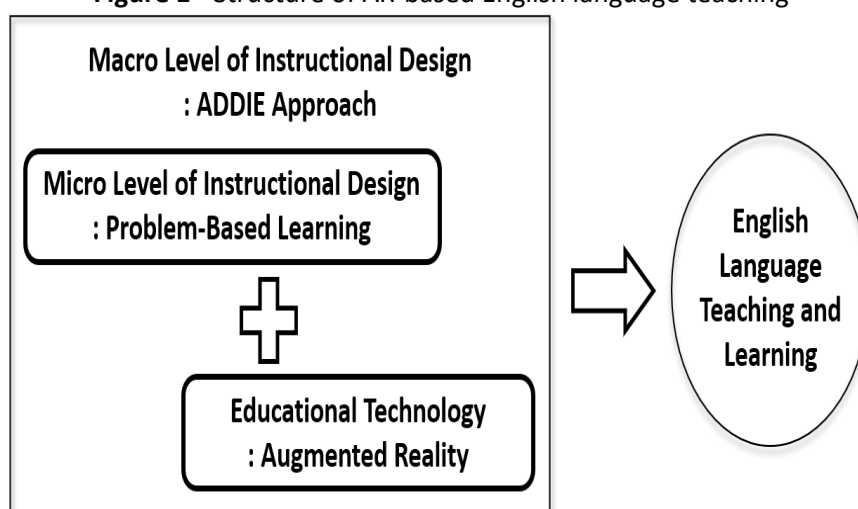
Source: Authors' elaboration.

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[1] This research was conducted at the Department of Teaching and Learning/ School of Education and Human Development at the University of Miami-USA. The statements made herein are solely the responsibility of the authors.

In order to reach this objective, first we will present a brief retrospective view of the Brazilian English language teaching scenarios to which our proposal is addressed; second, we will provide definitions to ADDIE approach, PBL and AR into the context of English language teaching with technologies; third, we will propose the integration of the foregoing approaches through practical examples. Our discussion envisions possible impacts of appropriating augmented reality in language teaching classrooms, especially considering the particularities of a continental-scale country as Brazil during the paradoxical times we live in.

ENGLISH LANGUAGE TEACHING: A RETROSPECTIVE VIEW OF THE BRAZILIAN SCENARIO

Brazilian researchers have been studying – over the last three decades, at least – the reasons why students cannot develop useable knowledge of English as a foreign language in public schools (Celani, 1984, 1988; Barcelos, 1995; Coelho, 2005; Bernardo, 2019). The results raise three main issues which are important to be highlighted: the historical problems underlying the conditions for teaching; a stigma of the public-school teachers' incompetence; and the subjacent contents, methods and aims to the teaching of English language.

Coelho (2005) unfolds three key moments that pinpoint the historical problems faced by teachers and students of languages in Brazil. The first one, post-world-war II, refers to a time when there were just a few public schools that conducted what was called French style high quality teaching. However, just the elite had access to schools and the country faced high illiteracy rates. The second moment was the military dictatorship that ruled Brazil from 1964 through 1985. At that time, French teaching tradition was left behind, and the humanities, arts and foreign languages lost ground. The emphasis remained on technical skills, physical and patriotic education. Around the 1970's, the elite noticed the importance of learning English and started to focus on private language courses along with exchange programs, especially to the United States. Such a movement decreased investments in public schools and elevated the number of private schools, where middle and upper classes' kids started to be sent to. The third moment refers to post-dictatorship educational reforms and neoliberal policies. Despite the government efforts to restore investments on public education that were reduced during the dictatorship times, high quality teaching in public schools is still something hard to be achieved, especially because of the neoliberal policies that have been adopted since the early 1990's and prioritize private institutions.

Concerning the stigma of public-school teachers' incompetence, Bottos (2008) explains that, on a daily basis, the press pictures teachers as responsible for poor quality teaching as far as productivity, competitiveness and profitability of companies is concerned. Those issues are strictly related to fundamental motto of capitalist societies rather than the teachers' duties in their daily practices. The author posits that the clash between expansion and disqualification of the Brazilian public school shown in many headlines is disseminated in society and welcomed by private school institutions, which serve as a criterion to "evaluate" both quality and lack of quality. The private school model appropriates the business nexus mainly due to its structural conditions and offers appropriate responses to the market. In this context, the press is also responsible for legitimizing the efficiency of private language courses over public school teaching.

More recently, Bernardo (2019) stated a thorough analysis on the subjacent contents, methods and aims for teaching English language. On a wider scale and affected by the structural problems aforementioned, teachers tend to focus on teaching the reading of small written texts and to expose students to grammatical aspects of the language, based on a coursebook. Sometimes exercises on the board are replaced by the ones on the coursebook. On a smaller scale, teachers complain about their long working hours, the high number of students per class, the precarious physical structure and the school's meager materials. They realize they teach a subject that does

not have a serious status *vis-à-vis* their own peers, who think that it exists in the school curriculum only to meet a worldwide demand and curriculum formality. Based on Freeman (2016), the author explains that these contents follows an *on-ramp perspective*, which seeks to prepare students for later school stages, taking the language as a "subject-language", that is, the contents are reified in its constitutive elements in order to objectify it. Language is taught as an object of discourse and not as "language in the world" – or the language used in its functionalities in the world – since the work with oral production is not effectively developed.

ENGLISH LANGUAGE TEACHING WITH TECHNOLOGIES: AN OVERVIEW OF THE ADDIE APPROACH, PROBLEM-BASED LEARNING, AND AUGMENTED REALITY

The ADDIE approach

The Instructional Systems Development (ISD) is intended to be used to develop education and training programs consistently and reliably through the process of systematic analysis, design, development, implementation, and evaluation to solve various problems of human education and learning (Gustafson & Branch, 2007). ADDIE, as the basic approach of ISD, refers to the name that has taken the first letters of each stage: *A*nalyze educational needs to find the solution, *D*esign, *D*evelop and *I*mplement lessons and *E*valuate the effectiveness of the developed program formatively and summatively.

The ADDIE approach has five characteristics (Branch, 2018). First, it's "Systematic". Each step of ADDIE is carefully prescribed and follows a specific logical sequence. Second, "Systemic", which refers to a holistic view of dynamic interactions, and instructional designers should be aware of the interdependencies between the entire instructional systems components. Third, "Reliable". The reason why the ADDIE approach has a reliable characteristic is that each step can be performed equally regardless of specific learning contents, contexts, teachers, location, and so on. Fourth, "Iterative". This is because the ADDIE approach is likely to be repeated infinitely throughout the production of the educational program in Analysis, Design, Development, Implementation, and Evaluation phases. Fifth, "Empirical". ADDIE makes effective decisions based on various data to suit the trends on the times.

Due to these characteristics, the ADDIE approach has been still widely used as the instructional model in various education areas, ranging from K-16 education (Gustafson & Branch, 2007), adult education (Branch, 2009), online learning (Shelton & Saltsman, 2011), and technology-integrated learning environment (Ching & Roberts 2020; Hidayanto et al., 2017).

ADDIE approach has been systematically used in order to develop teaching materials, coursebooks, modules and lesson plans as far as the teaching of English as a modern language is concerned. On K-12 context, for instance, Yüzen & Karamate (2016) reported the creation of a computer-assisted material related to the instruction of digits and numbers in English for 4th graders in Turkey. Alodwan & Amolsa (2018) assessed the effectiveness of a computer-based program to develop 9th graders' listening and reading comprehension skills in English. ADDIE was also used in research on higher education level, such as: the semantically-driven academic writing lessons to advance undergraduate students' academic writing skills for essays, course papers, project proposals, and independent studies (Thienthong & Suppasetseree, 2016); an ESP (English for Specific Purpose) coursebook directed towards Business Administration students, named Business English 1 (Iswati, 2019); and a translation model created for students who were pursuing a bachelor's degree in Translation and Interpretation (Surgawi, Joebagio & Djono, 2019). All of these researches thoroughly followed the five phases of ADDIE in order to construct their proposals. They stated its effectiveness regarding the support for developing materials and methods that would help to improve their students' language skills.

Problem-Based Learning

Problem-Based Learning (PBL) is a representative teaching model based on constructivism (Savery & Duffy, 1995; Tempera & Tinoca, 2022). A set of activities is used to obtain the suitable knowledge and thinking skills to solve the problems. Learners can actively involve in problem solving through collaboration with peers and exchange different opinions in complex issues related to real life (Savery & Duffy, 1995). The key to implementing PBL is that the given problem should motivate students and be based on the authentic tasks. However, the existing tasks utilized in PBL are limited to the providing process, such as texts and two-dimensional images, although the contents of tasks might be interesting. That often causes the reduction of motivation and boredom. Moreover, it is too difficult for students as a novice to find the suitable information for solving the problems and to handle large amounts of information without any experience or guidance (Macklin, 2001). Thus, in PBL, the medium to guide and motivate the students into the right direction for learning is required (Hmelo-Silver, 2004). This support as the medium should play a role in increasing students higher-order skills such as problem-solving skills, deep understanding of content and argumentation skills. In addition, the support should enhance students' interest and maintain their focus.

In the field of English language teaching, recent literature has reported the use of PBL as a valid choice for teachers and students to collaborate and construct knowledge of language as social practice based on real life issues (Lin, 2015; Campos, 2017; Rillero & Camposeco, 2018; Mohdali et al., 2018; Caswell, 2019). As an example of how PBL may contribute to the development of language skills, Campos (2017) conducted an exploratory and descriptive research aimed at 54 pre-service teachers' perceptions on the impact of a PBL activity for mastering key competencies, such as higher order thinking skills, knowledge transfer/integration, social, and self-management skills in their students' learning of English as a modern language. The results suggested a comprehensive impact on all the skills, but the impact on social and self-management skills still require further adjustments and studies.

Mohdali et al. (2018) developed a model guide specifically for language practitioners to craft PBL cases for developing language skills. Named PBL-LcCRAFT (Problem-Based Learning Language Case Crafting), the model aims to create opportunities for involvement in collaborative activities that require creative, critical, communicative and technological skills, which are supposed to have them ready to face life and career skills to prepare them for the job market. As an example, the authors describe a PBL-LcCRAFT case that required learners to look into a bully case based on a newspaper report. Students were supposed to search for relevant information online and create a poster using graphic design. Therefore, they were self-directed through group collaboration and technology use focused on language as a social practice in order to complete the assigned PBL case.

Augmented reality for language teaching

One of the tools that may have infinite possibilities as an educational technology is Augmented Reality (AR) (Damala et al., 2008; Sylaiou et al., 2010). AR means technology that shows the real and virtual world on the screen of hand-held devices in real time through the utilization of various sensors such as GPS, Gyroscope, and CMOS image sensor (Yoon et al., 2012; Peddie, 2017). Especially, AR has the function to make a phenomenon or materials that do not exist or are invisible in real world visual, and it is suitable to apply the scientific concepts or principles that are difficult to understand without the specific evidence and resources (Yoon & Wang, 2014). As a medium in PBL, AR can play three roles as follows.

First role is a provider of information. AR-based content provides realistic information to the learners, and it attracts their attention as a new educational material that implements direct manipulation activities (Damala et al., 2008). Moreover, AR can provide the visualized three-dimensional images with the real size and shape, and the students can experience firsthand various types of the objects and so on, which are impossible or difficult to see in the real world (Bimber,

Encarnação, & Schmalstieg, 2003). It can be also helpful for students to better understand the situation and contents of problems as experiencing the content's true context within the realm of their classroom experience regardless of the place and time than if they were to learn something with two-dimensional resources from textbooks or the internet.

Second role of AR is motivational support. It is possible to design the learning with gamified story as utilizing AR (Dunleavy, 2014). Gamification means using game-design elements in non-gaming contexts to enhance the motivation and interest in a certain activity. Learners can assign a real role and conduct the task through AR like massive multi-player online role-playing game. Students can participate in the activity with the perspective of a role directly related to the problem-solving. This activity can enhance students' motivation as fostering their engagement in the given tasks.

Third role of AR as an educational medium is to enhance collaborative learning. Group working in PBL is an element that gives opportunities to reflect upon students' claims and articulate their thought through communication (Savery & Duffy, 1995). AR can take advantage of easily inducing the group activities due to its mobile-learning characteristics (Wu et al., 2013). That is, learners can keep contacting with peers or instructors with no bounds on time and place (Evans, 2008). They can share their opinions at the real time and immediately receive feedback from one another. Because of the effective social networking service, such as Facebook and Twitter, it can be easily applied to AR system, providing the cyber-space to show the peer's previous activities or discussion.

Research has shown how AR may be used to teach English as a modern language on different levels of elaboration and purpose, ranging from skills that require diverse cognitive and linguistic skills such as the writing system to dynamic ways of learning vocabulary, i.e. through games. Liu & Tsai (2013) developed an exploratory case study regarding the use of AR-based mobile learning material in EFL English writing of essays. Visual information, information expressions and information accessibilities were among the functionalities offered by their material. The results showed more involvement of the participants in the learning of writing, especially because of the students' involvement in constructing linguistic and content knowledge while producing meaningful essays.

The teaching of English language vocabulary to 6th through 9th graders by a memory game named MemoryUFV was developed by Alves & Souza (2017). They used the resources offered by Unity3D platform as a fun way of learning words in English as well as providing follow-up exercises based on the contents that were taught by their language teachers at school. The results show that students motivation increased, especially when it comes to objectivity, satisfaction and learning while performing the tasks. 60% of the students rated the game as "excellent" and "very good".

Most recently, Redondo et al. (2020) focused on improving motivation, learning and socio-affective relationships while teaching English as a foreign language in early childhood education. The study assessed if the use of AR in the previous context improves the learning of the language, increases students' motivation and helps children at this age to establish more positive socio-affective relationships. A quasi-experimental study with an experimental and a controlled group was carried out with 52 and 50 early childhood education students, respectively. The results show a significant improvement in motivation, learning and socio-affective relationships in the experimental group, who completed instruction where AR was employed as a teaching tool, in comparison with the controlled group.

Integrating ADDIE, PBL and augmented reality in English language teaching

As advocated by Paiva (2019) regarding the appropriation of augmented reality in the teaching of English language in Brazil, table 1, hereafter, summarizes our understanding of how the ADDIE approach can be associated with PBL to teach English language at the public-school contexts:

Table 1 - Our proposal according to Branch's ADDIE concept

	Analyze	*Design*	*Develop*	*Implement*	*Evaluate*
Concept	Identify the probable causes for a performance gap	Verify desired performances and appropriate testing methods	Generate and validate the learning resources	Prepare the learning environment and engage the students	Assess the quality of the instructional products and processes, both before and after implementation
Common procedures	1. Validate the performance gap 2. Determine instructional goals 3. Confirm the intended audience 4. Identify required resources 5. Determine potential delivery systems (including cost estimate) 6. Compose a project management plan	1. Conduct a task inventory 2. Compose performance objectives 3. Generate testing strategies 4. Calculate return of investment	5. Generate content 6. Select or develop supporting media 7. Develop guidance for the student 8. Develop guidance for the teacher 9. Conduct formative revisions 10. Conduct a pilot text	11. Prepare the teacher 12. Prepare the student	13. Determine evaluation criteria 14. Select evaluation tools 15. Conduct evaluation
	Analysis summary	*Design Brief*	*Learning resources*	*Implementation strategy*	*Evaluation plan*
Our approach	Possible causes for performance gap stem from popular focus on translations along with excessive prescriptive grammatical rules at public schools	Desired performances take into consideration real environments for mastering language skills hinged on public school English language students'	Learning resources include those that connects students to real and virtual worlds through augmented reality on the screen of hand-held devices (Yoon	Implementation follows two phases: 1) teachers' pre-service/ in-service formation through extension courses at the university 2) public school students'	Following each school curriculum guidelines, the learning resources established during the design phase may be evaluated through hereafter suggestions, based on Branch (2009, p. 160): • Survey • Questionnaire

| | (Bernardo, 2019). They prevent students from learning language as a social practice. | current interests. Testing methods are supposed to be in line with local schools' curricula guidelines, such as mock tests and formative assessment. | et al., 2012). Group working in PBL is also an opportunity to reflect students' claim and articulate their thought through communication | engagement through lesson plans taught by either a student teacher (in pre-service contexts) or the schoolteacher (in in-service contexts) | • Interview
• Likert Scale
• Open-ended questions
• Examinations
• Role plays
• Observations
• Practice
• Simulations
• Authentic work tasks
• Performance checklists
• Supervisor assessments
• Peer reviews
• Observations |

Source: Authors' elaboration based on Branch (2009, p. 21).

As far as the *Analyze* phase is concerned (Branch, 2009), causes for performance gap in ELT may be identified from the three following categories, i.e., (i) lack of resources: neither wi-fi connection nor digital devices is available at most of Brazilian public schools; (ii) lack of motivation: students are overwhelmed with grammatical rulers and deprived from practicing language in real social contexts; (iii) lack of knowledge and skill: students are taught *about the language* rather than *the language itself*, which prevent them from taking risks at performing speaking activities.

The previous categories lead us to generate goals that are supposed to respond to performance gaps. Instead of dealing with gap-filling writing exercises that manipulate grammatical rules, students may be challenged to get involved in authentic experiences of language learning. Therefore, when we determine instructional goals, we are stating what the students will be able to do as a result of participating in a course: improvement in all four skills of language learning for instance (speaking, reading, listening and writing). While determining instructional goals during the *Analyze* phase, it is necessary to confirm the intended audience namely, "group identifications, general characteristics, number of students, location of students, experience levels, student attitudes, skills that impact potential to succeed in the learning environment" (Branch, 2009, p. 37-38).

The instructional designer concludes the *Analyze* phase after completing three other tasks, as Branch (2009) puts it. The first one is identifying required resources, meaning, the designer states what content resources, technology devices, instructional facilities and human resources are required to complete the process; the second one deals with determining which of the potential delivery systems may be used to close the performance gap, i.e. are they physical face-to-face meetings, computer-based training, video, internet-based learning management systems or blended systems?; and the third task refers to composing a project management plan, which is structured by two rules: 1) a project has a beginning, middle, and an end; 2) a project is measured in terms of quality, time, and money.

The *Analyze* phase is thoroughly context driven and will set the pace to the next phases. Desired performances of students and the appropriate testing methods are at the core of the *Design* phase from the ADDIE approach, which starts by: specifying the desired performances; identifying the primary learning tasks required to achieve a goal; inventorying the steps required to perform complex tasks; and facilitating a way to determine learner readiness (Branch, 2009).

Based on our previously stated *Analyze* phase, PBL may be a possible alternative pedagogy to promote designed performances in ELT during the *Design* phase, mentioned in the previous paragraph. The components of a performance objective, in the *Design* phase, answer the following questions: what will the student do? What are the conditions/circumstances under which the performance is expected to occur? And what is the quality or standard of performance that is considered acceptable?

Studies (Cunningham & Duffy, 1996; Savery & Duffy,1995; Wolff, 2007; Cook, 2011; Sultana & Zaki, 2015) have found that learner-centeredness and communicative paradigms are met and reconsidered, since contextual problems are tackled. Student-centered teaching methods such as PBL develop students' confidence and leadership skills by promoting cooperative learning environment. As suggested by Sultana & Zaki (2015), conducting PBL lessons in ELT promotes project activities in small groups and the problem of large classes can be addressed effectively as students are divided into groups of four to six members. As students collaborate on different projects and sometimes different aspects of the same project, "this leads to the authentic integration of skills, processing of information from varied sources, and culminates in an end product that can be shared with others" (Sultana & Zaki, 2015, p. 159). Thus, PBL is potentially motivating and stimulating on the one hand, and equally empowering and challenging on the other. Wolff (2007) clarifies that empirical studies related to PBL has important cognitive learning outcomes, such as better course achievement, retention, problem-solving skills, use of learning strategies, increased motivation and reduced learning anxiety. As far as the *Design* phase is concerned in ELT classrooms, essential performance tasks may involve role playing discussion topics, teamwork, power point presentation, problem-solving, poster-competition, research gathering, preparation of test paper, time management, class magazine, information synthesizing, group wall display, quiz, biographies, utilizing high-tech tools, reviews of books, creative writing, websites, letter writing, campaign, charting, fund-raising and games (Sultana & Zaki, 2015; Kavlu, 2018).

In the *Develop* phase, the specific instructional strategy, the tool, and media to implement the planned instruction, and learning resources are confirmed and developed. If PBL is selected as the instructional strategy, the learning activities and the specific tasks for each stage of PBL should be determined, as shown in table 2:

Table 2 - PBL learning activities and tasks at the Develop phase

PBL stage	Goal	Learning Activity Format
Defining the problem	In this stage, students need to talk about the given problem based on their prior knowledge and experience with the group members and share their roles in the group for problem-solving.	Entire Class – Individual – Group
Gathering Information	Individuals plan how to solve a given problem. After discussing a tentative solution with group members, they need to: a) draw up what they already knew and need to know for the problem-solving and; b) make an information collection plan. The roles are divided among the group members according to this plan and individuals begin to search for the information.	Group – Individual
Sharing Information	Group members share the information they found and determine the valuable ones by the discussion.	Group

Generating possible solutions	Individual tries to solve the problem according to their roles and shares it with group members.	Individual – Group
Determining the best-fit solution	Group members review the potential solutions and their pieces of evidence and determined one best-fit solution.	Group
Presenting the solution	Each group presents the learning results in front of the entire class and conducts peer-evaluation.	Entire Class – Group

Source: Adapted from Hmelo-Silver (2004) and Sage; Torp (2002).

If the specific development of the PBL process is completed, the next step is to select or develop the tool to accomplish the performance objectives. For the successful accomplishment in PBL, it might be important for students to directly experience the problematic/given situation telling the real case scenarios and AR can be regarded as one of the effective tools for this purpose. The following example – see table 3 – shows the authentic/ill-structured problem in PBL for ELT.

Table 3 - Examples of authentic/ill-structured problem in PBL

Targeting Population	8th Grade Students
The authentic problem	A week from now, Susie will travel to London with her friends. To be a meaningful trip, Susie wants a) to learn about London's landmarks, food, culture, and the activities she can do in London and; b) draw up a travel plan. However, this travel plan should be written by English and the expression "be going to" must be used.
Learning Plan	A teacher hands out papers describing famous places, foods, culture, and activities students can do in London. And the teacher provides the vocabulary and vocabulary puzzle books to reduce the learning difficulties of PBL. What students need to solve is selecting four places to visit in London and writing their travel plans in English for a total of four days. After deciding the visiting places, students can begin the virtual trip through AR. Students can write virtual notes about the feeling and information on the places they visit in virtual London.

Source: authors' elaboration.

Figure 2 shows VR glasses that can be suitable for younger students and the actual augmented reality scene to support students' above-mentioned activities in PBL. The existing AR tool had many shortcomings for use in the field of education. For example, high-immersive AR headsets supporting head-mounted display don't allow for sufficient exploration time on VR due to the motion-sickness and heavyweight and the high costs of headsets are inadequate for educational use. And in the case of AR module using smartphone or tablet PC, the small screen makes it difficult for users to immerse themselves in AR. To address these limitations, new AR glasses combining the advantages of the existing AR tools have appeared. AR glasses are the wearable device that shows the AR contents from a smartphone through a lens. The content screen is placed in the 360-degree space surrounding the user who can easily feel a sense of immersion due to maximumly 100 inches of screen size. Besides, the cost of AR glasses is much cheaper than that of the existing AR headsets, which can make the AR-based instruction scalable to most schools that cannot afford expensive AR technologies.

Figure 2 – VR glasses and a VR screenshot from traveling to London

Source: authors' elaboration

Prior to implementing the proposed learning activity, the *Develop* phase still needs a decisive step, which is conducting a pilot test with students who have the same profile as the intended target audience. One of the reasons why the pilot test is applied is because the developer may have an idea whether or not the expected objectives of the lesson are met. Besides, there is still time to make additional steps or adjustments in the process before the implement and evaluate phases.

Pre-service and/or in-service teacher formation through extension courses are at the core of the *Implement* phase, whose aim is to prepare the learning environment in order to engage students via lesson plans. Table 4 depicts what Branch (2009, p. 136) claims to be one the most effective courses that include "opportunities for practicing the facilitation of the newly developed instruction". Our proposal adapts the author's components for preparing teachers within any instructional delivery system. The case in point tries to comprise the shortage of in-service educational programs in Brazil as well as a precarious pre-service teacher formation previously mentioned, especially concerning the preparation of teachers of English for speakers of other languages.

Table 4 - Teacher formation course

Parts	Content
A (Introducing)	- Introduction; - Review goals and objectives; - Review information from the Analyze phase; - Review the original performance gap; - Review theoretical background on augmented reality, problem-based learning and English language teaching pedagogies; - Describe relevant parts of the analysis summary and learner profile; - Align teaching goals and tasks; - Review the number of students per class;
B (Microteaching)	- State the main teaching points; - Acquaint oneself with the instructional materials previously chosen, either analog or digital (delivery system); - Each teacher is given one or more lessons to present in a Microteaching task. The remaining teachers take the role of students. Exchange roles;
C (Evaluating and getting ready to teach)	- Questions are discussed as they are raised; - Teachers evaluate potential barriers to teaching; - Teachers evaluate potential barriers to learning; - Prepare for managing potential challenges;

Source: Adapted from Branch (2009, p. 136-149).

This outline for a teacher formation course might be adaptive and adapted to the intricacies of each region where it may be applied in Brazil. Reviews, descriptions and the way microteaching will be conducted can vary from context to context. A possible schedule is supposed to be discussed previously, and it depends on the available funding from the host university as well as the public school where teaching will take place.

Despite being the last phase of the ADDIE approach to instructional design, *Evaluate* permeates the whole process with regard to assessing the products of processes geared towards learning a modern language in both formative and summative perspectives. Since our proposal aims to integrate PBL and AR to the teaching and learning of the English language in a large and diverse country as Brazil, it is necessary to be aware of what each school curriculum guidelines recommend. The idea is to state "whether the quality of the learning resources satisfy the standards established in the Design phase" (Branch, 2009, p. 152). Our approach to the evaluation plan suggested on table 1 ranges from surveys, questionnaires and examinations to more practical propositions such as interviews, role plays and authentic work tasks. Table 5 exemplifies how it can be done through the 5 W's & H elements.

Table 5 - Suggestion for the Evaluate phase in an English language classroom

Level of Evaluation	Who	What	When	Where	Why	How
Perception	Administered by the teacher	Measure students' participation	After the conclusion of the course	In the classroom	Determine degree of engagement and satisfaction with the class	Survey, self-assessment, interviews.
Learning (along with performance)	Administered by the teacher	Measure students' skills on language use and digital literacies	During the course and after the conclusion of the course	In the classroom	Determine students' potential to perform tasks in modern languages in the context of ubiquitous communication	Survey, self-assessment, role plays, interviews, practice, authentic work tasks

Source: Adapted from Branch (2009).

Identifying both potentialities and fragilities of the teacher formation course may be a valid initiative since ongoing improvements as well as improvements for consecutive projects can be made. While conducting the *Evaluate* phase of our proposal on this article, the teacher may focus on two levels – perception and learning – instead of three separate levels– perception, learning and performance. We understand that, since there is integration of ADDIE and PBL into a more authentic use of the English language through augmented reality, the performance level is already imbedded in the second phase, i.e. learning transfer needs to happen in the classroom while using mobile devices along with social practices of language.

DISCUSSION

Our proposal aims at addressing historical gaps in the performance of public-school English language students in Brazil. Student-centered pedagogies favor knowledge producing through student-student interaction which is supervised by the teacher. Knowledge consuming, on the other hand, prevents students from giving essential steps for language practice, such as group discussion,

role-plays and interviews, and those elements may be crucial to the meaning-making about digital technologies and their impacts on our relationships, communication and learning through mobile devices. Nowadays, the case in point is to pay more attention to the increasing local diversities as well as the global and local connections.

We chose ADDIE as an approach to integrate both PBL and AR in the teaching of language because we are in line with Branch's (2009, 2018) perspective of generating episodes of intentional learning. Besides, in a continental-scale country as Brazil, identifying students' performance gaps and systematically work on them have to do with taking into account historical structural inequities. This way, we can avoid dangerous generalizations that limit students from engaging in authentic problems as the one we suggested to 8th graders. Through ADDIE our language students may be prepared to make meanings of the world instead of accomplishing the so-called *"on-ramp"* perspective, that only targets later school stages.

When it comes to the work with the English language, Kalantzis & Cope (2012) and Kalantzis, Cope & Pinheiro (2020) explain that we make meaning not only through graphic written texts, but also through visual texts such as photographs, images as well as sounds, aspects of time, space and behavior. In this context, AR plays an essential role in promoting what the authors call *learning by design* i.e, in the classroom, students: experience situated practices via different ways of communicating reflected upon new or unfamiliar experiences and interests; conceptualize, define and systematize theories; critically evaluate their own and other people's points of view; and apply their knowledge to the real world as well as have their say at different contexts. Thus, students are prepared to deal with cultural and linguistic differences that are central in our lives. Reading small texts and exposing students to grammatical aspects of language based on a coursebook is no longer an only option.

Not only are innovative practices essential to engage our students in learning languages in the 21st century, but we also need to reinforce that students need to be prepared to live in paradoxical times. Pennycook (2020) explains that, despite having the possibility to fact-check events and statement via mobile devices, people may claim any kind of knowledge, which leads to a spread of sources of information that we had never seen before. PBL, as we propose here, promotes such rich learning environments that our students can participate in communicative practices in a very contextualized and situated manner (Gee, 2004; Rocha & Braga, 2020; Vetoshkin et al., 2022). By integrating PBL and AR technology in an English language classroom, we consider the "social, spatial and embodied dimensions of language learning" (Pennycook, 2020, p. 183), and start thinking about different possibilities to teach and learn in such critical times that are transformed by the presence of digital technologies.

CONCLUSION

In Brazil, teacher formation programs such as the one outlined on table 4 is generally offered through extension courses by Departments of Teaching and Learning of public universities. However, those are still ad hoc initiatives, especially if we take into consideration that we are referring to the largest country in Latin America whose scarce funding from the Federal government prevent scholars from designing both short term and long term courses, particularly when it comes to preparing teachers to teach with advanced technologies.

Heterogeneous classrooms drive us to reflect upon the schoolteacher's work, which is in the process of being restructured in a near future in the country and cannot be carried out without questioning the supposed expected homogeneity (Fuza & Miranda, 2020). Many public schools still struggle with Internet connection. Therefore, not only curricular aspects of schooling but also structural conditions for teaching need to be addressed. No short-term results should be expected, since those issues have deep historical roots that take time and effort to be fixed.

In regard to pre-service and in-service English teacher formation courses, we need to bear in mind that teachers ought to be prepared to apply knowledge to practice. Our proposal here addresses this demand by integrating advanced technology and a student-centered pedagogy through a systematic instructional design approach. Since students are not computers that have to store content – as explained by Freire (1968) while using the metaphor of students as containers to describe and critique the traditional education system the banking model of education – promoting abundant discursive relations in the classroom may be a valid choice to connect our students to read, speak, listen and write through systematized knowledge and experience in order to be prepared to live and transform such a complex and constantly changing world.

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