Personalizing VR Educational Tools for English Language Learners

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ABSTRACT

Virtual Reality (VR) provides a unique opportunity for non-native speakers of a language to learn within an immersive platform. This may be particularly useful for English Language Learners (ELLs), who may face many difficulties learning English and acclimating to their new environment and culture. However, many current educational tools use a static, one size-fits-all approach to teach students. We believe that empirical research in VR pedagogy—specifically focused on how to personalize and adapt to, and support second language learners (e.g., ELLs) in these interactive and immersive systems—is an important step in providing educational equity to those that may easily fall behind their peers due to cultural and language barriers. In this paper, we discuss the current state of ELL education, and propose personalized and adaptable VR educational tools to help reach a wide range of users with different skills, abilities, and needs.

CCS CONCEPTS

• **Human-Centered Computing** → *Virtual Reality*; *User Models*; *Interactive Systems and Tools*; • **Social and Professional Topics** → *K-12 Education.*

KEYWORDS

Virtual Reality; Personalization; English Language Learners; Education

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1 INTRODUCTION

Virtual reality (VR) is becoming increasingly accessible to a wider audience as hardware becomes more affordable and users can utilize their existing devices (e.g., mobile phones) to drive applications [8]. Moreover, VR content has significantly improved, showing remarkable promise for collaboration [24], simulation, and particularly in education [2, 18]. VR provides strong content immersion [28], allowing learners to interact directly with simulations and focus on the information presented to them, enabling a new educational medium that can fundamentally change how ideas are shared and experienced. With these advancements in content and cost, K-12 schools have begun to adopt these technologies as ways to engage their students with course materials [16, 23]. However, although the number of educational VR applications are increasing, they typically provide an non-ideal, one-size-fits-all experience for both content and types of learners.

Figure 1: High school students (English language learners) participating in a chemistry lesson in their class using virtual reality headsets and applications.

One particular group of learner that may particularly benefit from the immersive nature of VR are second language learners (see Figure 1) [25]. For example, in the USA, K-12 (primary) schools spend an enormous amount of resources (e.g., providing specialized classes, customized lessons or educational content, multi-lingual instructors, and translators) in serving English Language Learners (ELLs) [17], helping students learn English and get acclimated to the culture. ELLs are well studied within the education research community, but to a lesser extent in educational technology and VR communities. We believe that ELLs are an important user group to consider when designing educational VR applications because many will need additional support to succeed academically, educational policy typically requires fair access to all users, and solutions created for this group may be applicable and beneficial to a wider audience of users.

As these VR resources become more available to the masses, it has the potential to reach a wide range of users with different skills, abilities, and needs—especially those in under-served or underrepresented groups—so a static one-size-fits-all approach will not work for everyone. We believe that empirical research in VR pedagogy—specifically focused on how to personalize and adapt to [20], and support second language learners (such as ELLs) in these interactive and immersive systems—is an important step in providing educational equity to those that may easily fall behind their peers due to cultural and language barriers. This paper highlights the importance of thinking about secondary users of a system, and providing interventions and personalization to help them succeed.

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2 RELATED WORK

2.1 School Support for English Language Learners

ELLs can face a variety of issues in learning a new language that can benefit from a personalized approach [13, 15]. It is difficult to enumerate the different types of ELLs as they may be facing issues beyond linguistic and cultural integration. For example, some ELLs may be facing interrupted formal education [4], a lack of literacy skills in their native language [6], or even active or recent refugee status [26]. These types of issues put these ELL students behind their peers in academic readiness and achievement. Educational researchers currently agree that effective teaching for second language acquisition (i.e., English for ELLs) should be based on language development instruction combined with opportunities for second language usage [5, 15]. However, due to ELL students' diverse situational needs, the exact balance between direct instruction and learning through supplemental and complementary sources (such as online tutorials or mobile applications) is unknown [15].

Recognizing the differing needs of the diverse population of ELLs, there are a variety of programs that K-12 schools in the United States (US) (and other countries such as the United Kingdom) use across the country [13]. There is typically an intense introductory program for newcomers, lasting for approximately 3 semesters (1.5 academic years), intended to familiarize students with the cultural and educational routines of the country, region, and local community [13]. Next, schools place these students in a longer-term English Language Development program for the remainder of their public education. Transitional Bilingual Education (TBE) programs begin by teaching curriculum in the students' native language alongside English development, while reducing bilingual support as students develop proficiency in English. TBE is commonly integrated with a Sheltered Instruction (SI) approach where students learn core curriculum subjects via English instruction that has been adjusted for their language needs [6, 13]. Some schools also opt to use Developmental Bilingual Education (DBE) programs, which instruct students in both English and their native language, aiming to integrate students while preserving their culture and language [13]. However, while these method offer some level of personalization (e.g., there is a teacher or translator helping students with language instruction), school districts may not be able to hire enough instructors to support all the students and/or the languages they speak. Also, language instructors must have knowledge of the school topics being covered, and/or spend significant amounts of time with instructors to learn and translate the lessons beforehand.

2.2 Technological Support for English Language Learners

Educational researchers have examined how different technological solutions can help ELLs with their transition into learning English. Lopez used interactive white boards for an implementation of a digital learning classroom and raised ELL student achievement to performance parity with the rest of the class [22]. Liu et al. found that the use of mobile technology by ELLs transitioning from a bilingual to SI approach provided numerous benefits, including helping students: learn content and language, receive individual instructional support, and increase engagement [21]. Other research focuses on games and virtual/digital worlds. Chen explored adult ELL's use of an immersive digital world, "Second Life," for second language acquisition and found that the conspicuous features, immersion, and sense of tele- and co-presence within the game helped to engaged ELLs with the content [3]. Similarly, Zheng et al. investigated the effects of avatar embodiment, collaboration, and affordances of a virtual world, finding that ELLs with diverse language background preferred virtual environments that used minimal text/spoken language [34]. Finally, Freeman explored how a digital math application, Help Math, impacted ELL students' mathematical capabilities by using an interactive visualization to make associations between words and their meanings, concluding that "digital student directed learning environments, content, and tools must be purposefully designed and sensitive to diversity, in order to effectively redress academic inequalities and improve ELLs' learning outcomes" [12]. Her study highlights the importance of designing educational technologies with an explicit connection between the technology (HELP Math), content (math), educational approach (SI), and context (secondary ELL). These studies demonstrate the benefits of using virtual spaces and tools for education, and suggest that they might transition well into VR applications for ELL education.

3 PROPOSAL

In this paper, we propose adding personalization in VR educational tools for language learning and cultural acclimation. We believe that this would work best with the Transitional Bilingual Education style of programming with Sheltered Instruction. This would provide learners with a fully immersive world about specific school topics, that can be personalized and automatically adapt to their changing needs and skill level of their first and second languages. Non ELLs can also benefit by learning from a fully immersive and interactive world, and can conversely explore other languages within the context of the program.

Personalization can occur through information provided by the user that can generate a general user model (e.g., personality traits). Personality traits have shown to be a suitable general user model as it characterizes a person's thoughts, feelings, social adjustments, and behaviors, which subsequently influences their expectations, self-perceptions, values, attitudes, and their reactions to others, problems, and stress [19, 32]. Ideally, existing data sources could include single-sign on connections to users' social media accounts. Past work in this area has demonstrated that user-generated content from social networking services (e.g., Facebook [10], Twitter [27], and Instagram [9, 11]) can predict users' personality and preferences. These sites are typically configured in the users' first or preferred language, and may include culturally relevant information that can help with the VR educational tool. Posts can also indicate reading/writing level and the users' command of specific languages. Moreover, Ferwerda et al. have shown that even restricted Facebook accounts (that severely limit the amount of information provided) can be used to relaibly infer personality traits by by examining whether/which profile sections are disclosed by the user [10].

Personalization can also occur based on users' performance over time. For example, spaced repetition is a learning principle that depends on variable time intervals between reviews of previously learned content for increased learning [31]. This technique is common in language learning due to being well-suited for accumulating large vocabularies but is not limited to it [1]. The Leitner System [14] and SuperMemo [33] are some common implementations of spaced repetition. Existing applications use this technique to teach Cartesian product and relationships, highlighting the role of classification and categorization of content [30]. Additionally, implementation of spaced repetition in games and mobile learning, validate the flexibility that this technique affords in adapting to different platforms [29]. Modern approaches in this area depend on using machine learning and data science for personalized learning [31]. Existing algorithms can be implemented in adaptive learning scenarios [7]. The effectiveness of spaced repetition in language acquisition settings, along with prior research in ELLs' interactions with immersive systems (e.g., [3, 34]), are good indicators of the potential for using it in personalizable VR applications for English language learners.

As more people turn to new connected and immersive technology to learn new skills, there will be an increasing need for systems to understand and adapt to the needs of their users. We believe that personalizing and adapting content in VR instruction can lead to extensive benefits for learners. This is especially true for ELLs, who might not have complete command of a specific language, but can use another language and visual/tactile cues within VR to transition naturally from their first language to another. VR has limitless potential to place learners into an immersive world, and we hope that further research can help inform the next generation of engaging and effective VR educational tools.

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