Facilitating Communicative Ability of EFL Learners via High-Immersion Virtual Reality

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ABSTRACT: Developing communicative ability of English as a Foreign Language (EFL) learners is essential when it comes to authentic learning. Nevertheless, conventional textbook usage and English instruction often fail to be learner-engaging. With the help of high-immersion Virtual Reality (VR), language learning can be transformed into a more self-directed learning experience, using a simulated authentic environment to enhance engagement. Therefore, a three-dimensional learning system, Virtual Reality Life English (VRLE), was developed to provide learners with an authentic setting to facilitate communicative ability development. Seventy-two low-achieving junior high school students were recruited as participants. Multiple data sources were collected for both quantitative and qualitative data analysis of VRLE, including a pre-test/post-test addressing communicative performance, an Igroup Presence Questionnaire (IPQ) for the students' perception of perceived presence, and a semi-structured interview. The primary affordances were the beneficial application of VRLE to English communicative ability and an enhanced sense of presence in an EFL context. Furthermore, the students were positive about the learning experience. The study proves the potential of incorporating high-immersion VR technology in an EFL context. Nevertheless, the challenge of its accessibility needs careful consideration in future research to place VR in an advantageous position for language learning.

Keywords: Virtual reality, Presence, Immersion, Communicative ability, English as a Foreign Language

1. Introduction

Textbooks and related learning materials continually evolve to make studying English as a Foreign Language (EFL) more diverse and less challenging, often incorporating multimedia learning materials, such as video/audio CDs or MP3 files (Wang, Lin, & Lee, 2011). However, these materials often fall short of the ever-changing needs by providing a static and conventional paradigm, rather than an interactive representation of language (Lee & Chen Hsieh, 2018; Matsuda, 2017; McKay & Brown, 2016). In addition, most textbooks offer very limited opportunities for learners to engage in an authentic, meaningful learning context. Students are thus faced with the lack of practical contexts in the learning process (Chien, Hwang, & Jong, 2020). English is, therefore, often regarded as a traditional subject to master in the classroom rather than as a living language to be developed for exploring the real world (Chen Hsieh, Wu, & Marek, 2017), which is especially true in the EFL context.

Actual communicative ability, however, is crucial in English learning (Canale, 2014). Learning to communicate has been regarded as one of the greatest obstacles for EFL students (Zhang & Liu, 2018), since communicative ability not only encompasses inherent grammatical competence but also requires employing norms of usage and appropriateness in a variety of communicative situations (Hymes, 1972). Communicative ability is operationally defined in this study as the skillset and ability to achieve communicative goals in a contextualized setting, referring to the ability of EFL learners to employ English successfully in real-world situations, such as getting meaning across (see Abed, 2011; Rivers, 1972; Rouhi & Saeed-Akhtar, 2008) or responding to question prompts in a shop.

The rapid development of technology has made EFL learning and instruction more dynamic and has shifted the linguistic focus from grammar, vocabulary memorization, and sentence-mimicking to communicative applications. Online platforms, such as social networking sites (e.g., Barrot, 2016), Wikis (Zou, Wang, & Xing, 2016), and blogs (Pham & Usaha, 2016), have strengthened this new focus. While the importance of communicative skills in English learning is widely recognized by both instructors and learners, evaluation of English ability usually focuses on grammar and vocabulary as a detached part of the language. Whether learners can truly "use" English to solve problems and to communicate successfully in their actual daily lives is often neglected by instructors, especially in

junior high school. Since traditional English pedagogy is weaker in assisting EFL learners to achieve communicative objectives, there has been an urgent call for language instructors to adopt new techniques and tools to empower learners with the ability to get their meaning across by reacting and responding in a natural communication context (Luo, 2017).

Virtual Reality (VR) is gaining attention among language instructors because it transforms traditional learning materials into a live and self-directed interactive learning experience, thus increasing both motivation (Lanier, 2017) and language performance (Chen, 2016). VR allows learners to interact and immerse themselves in an authentic learning context without physically leaving the classroom (Huang, Rauch & Liaw, 2010). Other advantages of VR include providing experiential or contextualized learning, enabling learners to make meaningful connections, promoting active learning, boosting confidence and motivation, and fostering engagement (see Dawley & Dede, 2014; González-Lloret & Ortega, 2014; Sadler et al., 2013; Wang, Anstadt, Goldman, & Mary, 2014).

In view of the aforementioned benefits of adopting VR in learning, the researchers of this study self-developed a three-dimensional animation VR English learning system using head-mounted display, called "Virtual Reality Life English" (VRLE), where learners were able to study, practice, and apply English to achieve communicative tasks by engaging and immersing themselves in a real-life simulated context. The researchers were motivated to design such a learning system by a factual long-lasting classroom experience observed at a junior high school in a rural area in Taiwan, where most students receive relatively meagre resource of English learning, thus resulting in an overall phenomenon of low-achieving students with low motivation in English. Given the described situation, one of the initial goals of designing the VR learning system was to light the fire of language learning by bridging the gap of real-life language applications with the help of emerging technology. Once the goal was achieved, students would find their own way to drive their future learning. Accordingly, this study examined the effectiveness this VR learning system on English communicative ability and sense of presence among low-achieving junior high students in Taiwan. In addition, language performance and learner perceptions about the VRLE system were also explored. This research attempted to address the following research questions:

RQ1. To what extent did VRLE facilitate the communicative ability of EFL low-achieving learners?
RQ2. To what extent did VRLE affect learners' presence in the virtual environment?
RQ3. What were the learners' overall perceptions of the VRLE system?

This study is significant because, although previous research has shown the benefits of using VR, its effects on EFL learning have remained under-explored (Dolgunsöz, Yildirim, & Yildirim, 2018), let alone probing into the use of head-mounted displays among low-achieving learners in EFL contexts. Connecting communicative ability with VR in EFL settings has also been insufficiently examined. Even fewer attempts have been made among low-achieving learners, in comparison with the relatively richer literature focusing on experienced or moderately proficient learners (Levak & Son, 2017), thus making empirical evidence particularly scarce about how VR facilitates junior high school students with low English proficiency and motivation concerning their communicative ability and other learning related factors. This study aimed to self-develop a high-immersion VR system as an intriguing material in an EFL setting and further extended prior research by narrowing its focus on the effects among high-immersion VR, low-achieving EFL learners, their communicative ability, sense of presence, and learning perceptions.

2. Literature review

The assertion that VR could be conducive to learning achievement is widely supported by the theories of constructivist learning, contextualized learning, and immersive learning. Constructivist learning holds that learning occurs when learners construct new understanding by connecting new information with prior knowledge, experiences, and background (Vygotsky, 1978). Thus, a pedagogical design that leads to, for instance, real-life social interactions, embedded learning, self-directed learning, and student-centered learning can foster positive learning experiences and achievement (Huang, Rauch, & Liaw, 2010; Piaget, 1969; Vygotsky, 1978). VR-supported learning supports the constructivist instructional design (Lin & Lan, 2015). In line with constructivist learning, contextualized learning echoes the importance of supplying relevance between new information learned and existing knowledge. Students often are not shown the connection between their school learning and real-life applications (Hu-Au & Lee, 2017). Thus, learning framed with a context via VR empowers learners to visualize the purpose of learning in a more heuristic manner. Finally, immersive learning in language education allows learners to be naturally engaged in an

"embodied and perception-action rich context" (Legault et al., 2019, p.2). Immersion is also considered to be imperative to enhance communicative ability and language mastery (Wang, Petrina & Feng, 2017). As the immersive technology of VR advances, virtual immersion can be promising in boosting an authentic learning environment (Lin & Lan, 2015). Further, the levels and the types of immersion offered via VR have transformed over time, leading to a variety of VR systems in the market that suit various needs.

2.1. Low-immersion VR vs. high-immersion VR

VR has been broadly defined as a representation of an environment by simulation or replication where users can self-explore and interact (Lee & Wong, 2014; Makransky & Lilleholt, 2018). In a broad spectrum, VR can be divided into low-immersion and high-immersion, based upon how graphics are displayed (Checa & Bustillo, 2020; Kaplan-Rakowski & Gruber, 2019). Users conduct low-immersion VR, also named desktop VR, in a conventional computer-based environment, whereas high-immersion VR requires head-mounted displays (HMDs) or surrounding projection screens in a room setting (Estes, Dailey-Hebert, & Choi, 2016; Freina & Ott, 2015). While low-immersion VR is more accessible and cost-effective in educational applications, high-immersion VR delivers high interaction and a greater sense of immersion that cannot be replaced by low-immersion VR (Chang, Hsu, & Jong, 2020; Freina & Ott, 2015). As the technology of VR continues to evolve, learners have a better illusion and perception of being situated in the virtual world personally instead of experiencing it through an avatar. The VRLE adopted in this research was a high-immersion VR technology with real-person dubbing, motion capture, body-tracking interaction, and a VR controller to allow higher immersion to occur naturally, meanwhile, offering a near-authentic simulated context for language learning.

2.2. VR applications in language learning

VR use has proliferated in a wide array of disciplines, including language education, because it offers simulated scenarios that keep the engagement of users at a higher level. Chen (2016) noted that the virtual environment in the online platform Second Life could provide learners with visual and linguistic stimuli to facilitate language teaching and learning. In Lan's study (2015), the positive results confirmed that the usage of virtual contexts in EFL learning could: (1) provide students with learning opportunities without time and space limitations, (2) provide students with a game-like scenario for English learning, and (3) enhance the language performance of EFL learners. Another study conducted by Lan (2014) confirmed that VR enhances overall speaking skills and positive learning attitudes. Levak and Son's (2017) study affirmed that the listening comprehension of the learners was increased. Similar results in a study by Hassani, Nahvi, and Ahmadi (2016) suggested higher language proficiency and lower grammatical mistakes in the learners' performance through VR application. Further, communicative ability training can sometimes arouse public speaking anxiety. VR, however, offers learners a safe-to-fail environment and encourages trial-and-error learning (Chien, Hwang, & Jong, 2020; Chou, 2018). VR also enables natural interactions in an immersive simulated environment to enhance communicative ability that nearly no other type of media offers. The above studies also indicated that virtual reality could be a beneficial way to overcome the barrier of a limited EFL learning environment, supplying physically or psychological immersive situations for students to truly apply their English in response to communicative practices, hypothesized with a high sense of embodied presence in the virtual world (Vrellis, Avouris, & Mikropoulos, 2016).

2.3. Presence in VR

Presence, defined by Lee (2004) as the "psychological similarities between virtual and actual objects when people experience – perceive, manipulate, or interact with – virtual objects" (p. 38), is the key factor that shows the effectiveness of VR in various contexts. To be more specific, presence is the appeal of VR, creating the illusion for users that they are actually in the virtual world. From the perspective of language learning, presence in VR has the potential to immerse learners in the target culture, with which most EFL learners do not have frequent access. Witmer and Singer (1998) defined presence as the subjective experience of being in one place or environment, even when one is physically situated in another. However, presence is actually a complex and multidimensional perception that is generated through an interplay of multi-sensory information and various cognitive processes (Diemer et al., 2015). In this sense, presence is a normal awareness phenomenon that requires directed attention. It is

based in the interaction between sensory stimulation, environmental factors that encourage involvement and enable immersion, and internal tendencies to become involved. Wang, Petrina, and Feng (2017) said that the ultimate VR design incorporated in education should strive for both immersion and presence. The higher the perceived perception and awareness in VR, the higher immersion and engagement the user would experience in VR-assisted learning. Therefore, creating a strong presence in VR is one of the major goals in designing a VR language lesson, so that users become fully immersed in the language learning process. Presence, therefore, translates into higher motivation, which in turn translates into more confidence for using English, and in the long term higher EFL ability (Wu, Yen, & Marek, 2011).

3. Method

3.1. Participants

The participants in this study were 72 junior high school students in the ninth grade in central Taiwan. None had experience using VR systems before the study. The participants included 36 males and 36 females. Based on the long-accepted consensus in the local context of Taiwan, and since the school was located in a relatively marginal area in central Taiwan, the participants were in a disadvantaged learning environment due to limited English resources available to them. Their regular English instruction normally was limited to three hours a week, with the class time dominated by teachers lecturing on grammar and vocabulary. Only a small portion of class time was left for actual communicative experiences. According to their performance on the Comprehensive Assessment Program for Junior High School Students, around 80% of the participants were considered low-achieving learners. Their English proficiency fell between Al and A2 on the Common European Framework of Reference for Language (CEFR), indicating their ability to understand and use basic expressions related to areas of most immediate relevance or communicating on familiar and routine matters. Overall, despite formal English instruction received at school, these participants were regarded as low-achieving learners in English learning.

3.2. VRLE design

Rather than adopting commercial learning systems, the researchers developed a VR learning system, named VRLE, specifically for low-achieving students in a disadvantaged English learning environment, with a goal of increasing their motivation to learn English. To meet the students' needs, four experienced junior high school English teachers were consulted about the content of the system. Since the researchers designed VRLE as an alternative teaching material to the junior high school-based curriculum, the contents targeted commonly seen daily life conversations, including making reservations at hotels and restaurants, purchasing a toy, asking for directions, and ordering a meal. One of the learning scenarios, for example, was a toyshop where the students were required to purchase an assigned toy through communicating with the virtual clerk. Given the chosen scenario, the English instructors scripted scenes for the simulated contexts for life English learning, including English dialogues suitable for the low-achieving junior high school students. Then the system development team constructed the 3D models, multimedia contents, programs, and VR interactions according to the scripts. VRLE was developed based on Unity. The 3D model used 3Ds MAX and VR HMD using HTC VIVE and Kinect for image recognition and full-body interactive systems. Since this study aimed to create a learning environment where the students could practice authentic conversations in English, the VRLE system design incorporated the five factors that Usoh, Catena, Arman, and Slater (2000) identified as affecting the user perception of presence (as shown in Table 1).

Table 1. Comparison table of presence factors

Factors that affect presence	Elements in VRLE
High-resolution information display that enables participants to recognize the existence of the display devices	Realistic graphic design
Consistency of the displayed environment across all sensory modalities	Background sound effects Real-person dubbing Real-person motion capture

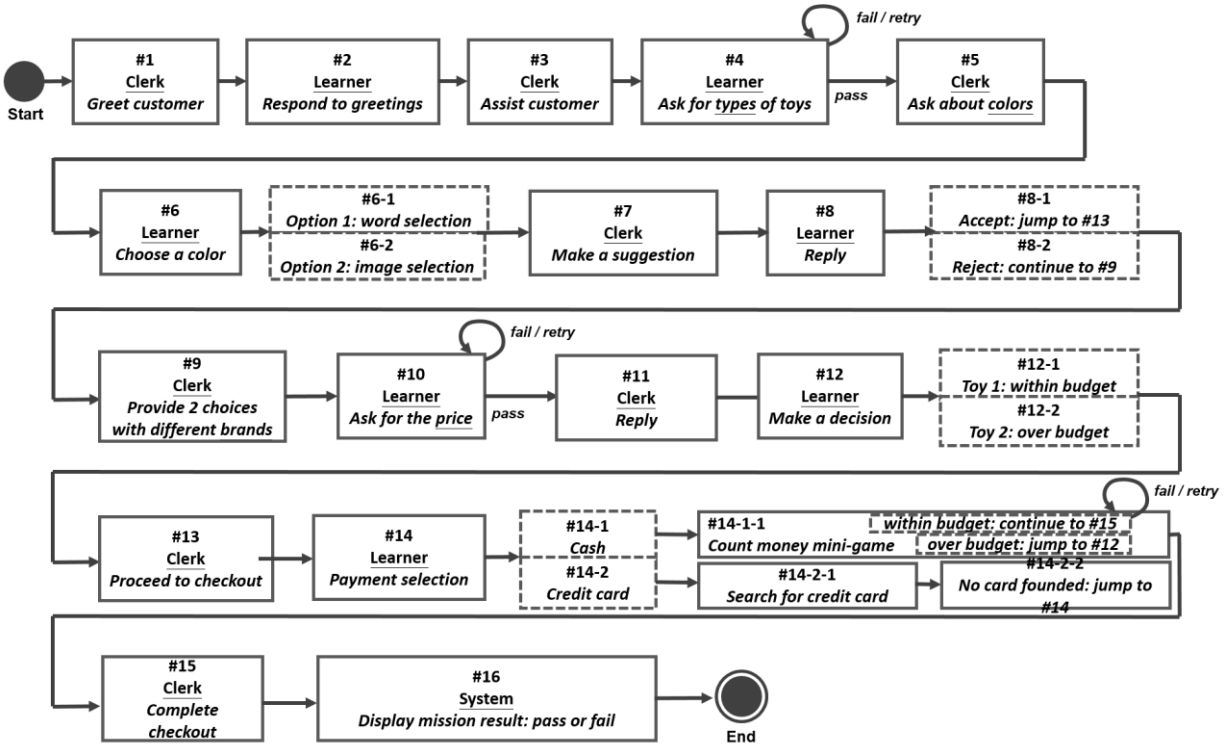
Being able to navigate through and interact with objects in the environment	Room scale setting Object taking
The virtual body should be similar in appearance or functionality to the individual's own body	Body tracking interaction
The connection between an individual's actions and effects of those actions should be simple	Flexible answering mode Pointing to select

3.2.1. The technical components of the system

- Realistic graphics: The settings in VRLE referenced real shop design and the characters in the system had body figures with real proportions.
- Background sound effects: Upon starting the learning task, users experienced realistic background sound effects that supported the visual surroundings, such as music or broadcasts commonly heard in a shop.
- Real-person dubbing: A native English-speaking teacher recorded the words and sentences spoken by the characters in the learning tasks, which generated a sense of reality similar to communication with a real person. Furthermore, when users pointed at a single word or finished arranging a sentence, the system provided corresponding pronunciation at the same time to strengthen the students' listening and communicative ability.
- Real-person motion capture: The system motion-captured every motion the user made in the learning task, such as waving their hands or nodding their heads, to simulate real situations.
- Room scale: With HTC VIVE's 360-degree tracking technology, users with headsets and controllers could physically walk around within a 7' x 7' play area. They could walk freely across the streets or enter into a room with their real-time motion reflected in the VR environment.
- Object taking: In the system, users could easily manipulate objects in the VR environment, such as picking up a toy car from a shelf or throwing trash into a trash can, with natural movement.
- Body tracking interaction: The system, integrated with spatial concepts and limb learning, provided an interactive interface that enabled users to use body language to communicate with others through the controller. For instance, if users did not know how to say the color "brown", they could simply point at or pick up a "brown object" instead.
- Flexible answering mode: The conversations in the system simulated real life situations; therefore, as long as the intended meaning was communicated, minor grammatical errors were acceptable. For example, when a user wanted to buy a toy car, a complete sentence such as "I would like to buy a toy car" or a brief phrase such as "buy a toy car" was considered acceptable in the learning system.
- Pointing to select: Due to the difficulty of identifying every user's voice, users in the system selected words to arrange a sentence to demonstrate their answers.

The sample task procedure of purchasing a toy is shown in Figure 1.

In this system, the students chose from several modes with variations in language level (easy or difficult), caption options (caption-on or caption-off), and an optional function for a time limit. After the initial setup, the students faced a task guided by an avatar. The task of purchasing a toy, for example, required the player to visit a place and respond to prompts initiated by the system avatar (see Figure 2 and 3). The mission clearly specified the kind, color, and brand of the toy the students should purchase (Figure 3). To accomplish the mission for communicative purposes, the students needed to understand the clerk's questions and use comprehensible sentences to express the need (see Figure 4 and 5). In addition to arranging different words into a sentence, the students recorded their responses into the system and picked up the objects in the system (see Figure 6 and 7).



***Task**: The learner needs to buy a toy for his/her little brother with random requirements (e.g., brand, type, color, price…)*

Figure 1. Task procedure in the system

Figure 2. Environment in VRLE

Figure 3. Mission in VRLE

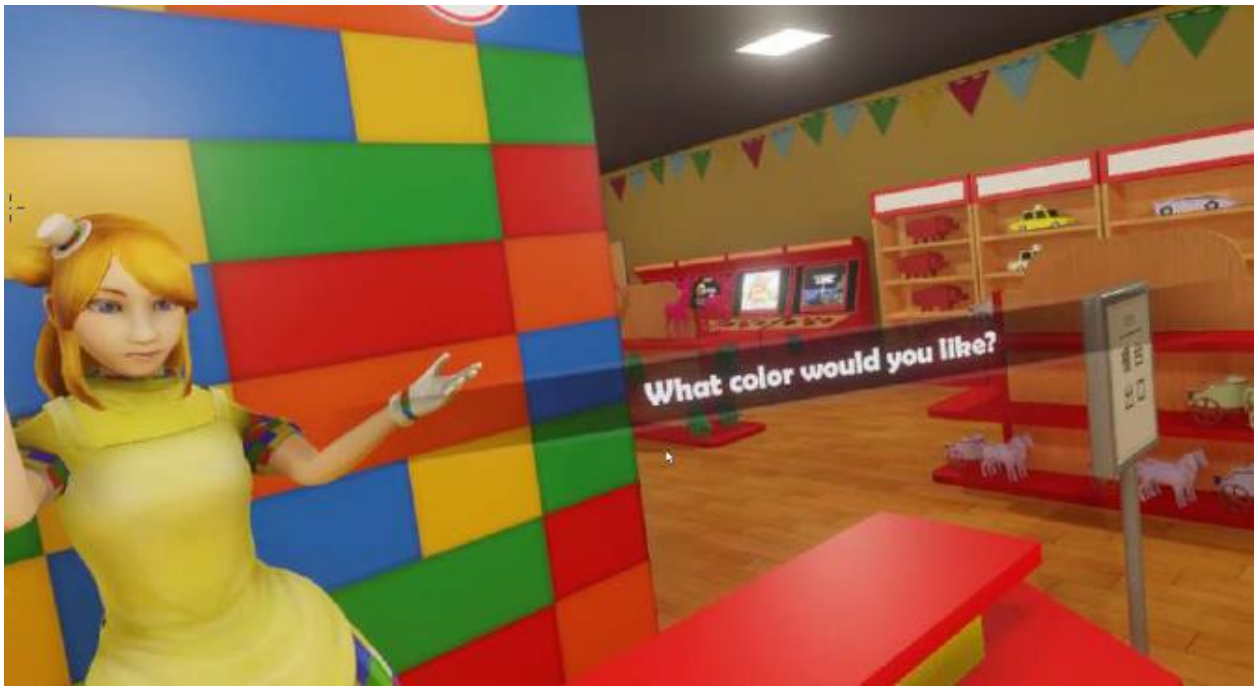


Figure 4. Communicative content in VRLE

Figure 5. Arranging different words into a sentence

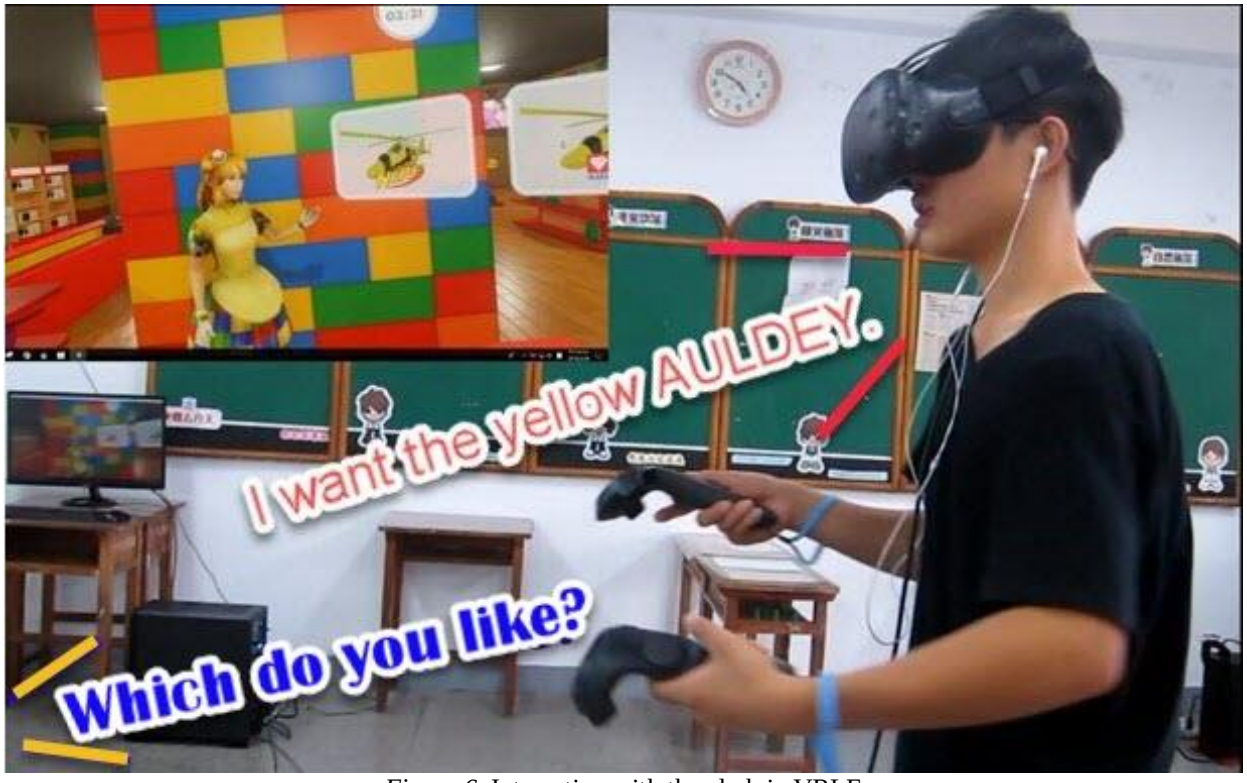


Figure 6. Interacting with the clerk in VRLE

Figure 7. Picking up the object

3.3. Research design

An affordance-based research design was adopted in this study, rather than an experimental/control group methodology. Affordances are "the qualities or properties of an object that define its possible uses or make clear how it can or should be used" (Merriam-Webster, N.D.). In teaching English, affordances define the capabilities and benefits that a teaching method or tool offers to instructional designers and students. When evaluating individual choices about learning technology, the affordances can be thought of as the effectiveness with which students can perform individual learning tasks (Marek & Wu, 2019).

The rationale for the affordance-based design of the current study originated from Colpaert's (2012) recommendation in his invited lecture for doctoral students that it is more valuable to study the affordances of a particular learning tool than to simply consider the differences between using or not-using the tool. He observed that so many different factors affect language learning that it is hard to predict whether the successful implementation of a technology-enhanced instructional design at one school will yield the same positive result at another school. In addition, because research participants are often students, there is a growing ethical concern about withholding learning experiences from some students in order to preserve a control group (Deygers, 2019).

Therefore, all of the participants in the current study experienced the VRLE system. The researchers geared data collection to understand the affordances of the system for teaching and learning, as embodied by the research questions about the communicative ability, sense of presence, and perceptions of affordances acquired by low-achieving EFL learners.

The VRLE included two modes, with one caption-assisted and the other without captions. The students first experienced the caption-on mode (Figure 8) and then the caption-off mode (Figure 9). It should be noted that while the system allowed the students to choose caption options, this study did not focus on how the sequence of caption provision affected the students' learning outcomes and perceptions. Rather, the purpose was to explore the students' perspectives about the caption mechanism in the VRLE system. To these low-achieving students, focusing on the learning tasks while at the time adapting themselves to the new learning system might make the students cognitively overloaded and lead to potential resistance to use the system. Therefore, to avoid confounding effects from different caption sequence designs on learning outcomes and perceptions, all of the students experienced the caption-on mode first and then the caption-off mode.

Figure 8. Caption-on mode in VRLE

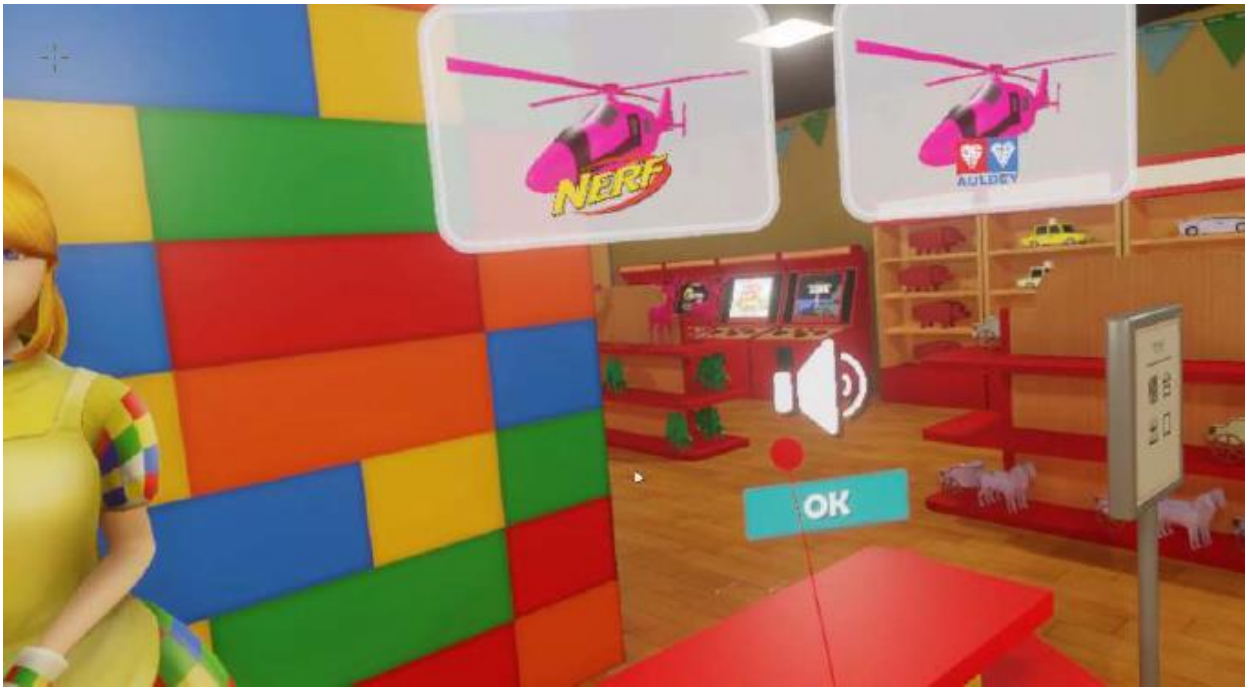


Figure 9. Caption-off mode in VRLE

3.4. Data collection and analysis

In response to RQ1 addressing the extent to which the VRLE system facilitated the communicative ability of EFL low-achieving learners, all of the students took an English pre-test focusing on communicative ability. It is worth noticing that to these low-achieving learners suffering from English instruction disadvantages, improvement in English learning meant basic abilities to get meaning across and to respond to linguistic cues in a communicative context. The researcher-developed pre-test assessed student communicative ability via listening and dialogic interaction, with each part containing 10 questions. For the listening part, the students listened to two people

conversing with each other (e.g., greetings, telephone chat, or weather of the day) and then rearrange those lines (around four to six) in correct order. As regards the dialogic interaction, the students listened to question prompts (e.g., "What is your favorite color?", "How is your day today?", "How's the weather today? Do you like it?") and made responses. The instructor and the researchers (also experienced teachers offering English instruction at universities) then graded the students' performances.

During data collection, the students were grouped into pairs by the teacher and each pair used the VR learning system outside the regular class time. All of the students experienced the four learning tasks embedded in VRLE, including making reservations at hotels and restaurants, purchasing a toy, asking for directions, and ordering a meal. Considering the potential side effects of dizziness and disorientation, each task lasted for around 15 minutes. Therefore, each student experienced the VRLE for around one hour in total within the four-week VR experience. Each students' VR learning experience was recorded on video for later examination. Right after the experiment, all of the students completed an English post-test. The post-test was identical to the pre-test in form, including listening and dialogic interaction. A paired-sample *t*-test examined whether significant differences existed between the pre-test and the post-test.

To address RQ2, the students responded to the Igroup Presence Questionnaire (IPQ) adapted from Schubert, Friedmann and Regenbrecht (2001) after the post-test, concerning the level of presence perceived in the VR learning setting. The original IPQ was comprised of 14 items rated in the form of a 7-point Likert Scale. The IPQ was used as a composite measure of presence with scores ranging from 14 to 98 and was divided into constructs assessing the four components of presence: overall feeling of presence, spatial presence, involvement, and realness. The questionnaire started with one item assessing the overall feeling of presence that the students perceived while using the VRLE system. Then, the construct of spatial presence contained five items assessing feelings that one was physically present within a virtual environment. The construct of involvement contained four items assessing attention to the virtual world. The construct of realness included four items assessing how real the virtual stimuli appeared. In addition, to explore whether different multimedia designs (i.e., caption-on and caption-off mode) affected the sense of presence, the researchers added the construct of caption-related presence with four questions, thus expanding the IPQ into an 18-item questionnaire.

Finally, to answer RQ3, about how the students perceived the use of VR for English learning, the students were invited to a semi-structured face-to-face interview. In answering, the participants (1) reflected on if the system provided an authentic setting, (2) compared the caption-on mode with the caption-off mode, and (3) made suggestions concerning how the system could be improved. The qualitative data was read repeatedly by the researchers and grouped into themes that recurred frequently. The researchers also analyzed their own notes on the experiences of the students for insights.

4. Results

The findings are organized in accordance with the research questions.

4.1. RQ1: To what extent did VRLE facilitate the communicative ability of EFL low-achieving learners?

To answer whether the use of the VRLE system in the experiment facilitated the low-achieving students' English communicative ability, descriptive analysis and a paired-samples *t*-test comparing the pre-test and the post-test were employed. Inter-rater reliability was measured with Krippendorff's alpha at .86, which is above the level considered the norm for good reliability (Hayes & Krippendorff, 2007). The results in Table 2 revealed that the mean score of the post-test (M = 68.82) was higher than that of the pre-test (M = 60.56). Further analysis using the paired-samples *t*-test (shown in Table 3) suggested that the students' performance on the post-test was significantly higher than that on the pre-test ($p < .001$), thus suggesting the facilitative role of the VRLE system on the communicative ability of the low-achieving participants.

Table 2. Descriptive statistics of the pre-test and post-test

Test	*N*	Mean	*SD*
Pre-test	72	60.56	23.16
Post-test	72	68.82	22.77

Table 3. Paired-samples *t*-test of the pre-test and post-test

	Paired differences					*t*	*df*	*Sig.* (2-tailed)
	Mean	*SD*	Std. error mean	95% *CI* Lower	Upper			
Pre-test – Post-test	-8.26	13.97	1.65	-11.55	-4.98	-5.02***	71	.000

Note. ***$p < .001$.

4.2. RQ2: To what extent did VRLE affect learners' presence in the virtual environment?

The responses of the students to the IPQ in Table 4 showed that the integration of VRLE for English communicative learning yielded an intermediate to upper-intermediate level of perception of presence, suggesting that most of the participants considered themselves as gaining a sense of presence in the VRLE learning environment. Among the five constructs, spatial presence (M = 5.31) topped the ranking, followed by overall feeling of presence (M = 5.27), caption-related presence (M = 4.48), involvement (M = 4.43), and realness (M = 3.88).

In terms of overall feeling of presence, the students generally expressed the feeling of being "in" the virtual environment when using the VRLE system, as evidenced by their responses to Item 1. The upper-intermediate level of perception regarding spatial presence (Items 2-6) suggested the students felt physically situated in the virtual space and that they felt a sense of action, revealing simulated authenticity of real-world scenarios in the VRLE system. As regards to the level of involvement (Items 7-10) in the VRLE system, while most of the students felt engaged in the virtual environment, they still experienced some interference from the real world, such as ambient sounds from their surroundings. In the construct of realness category (Items 11-14), the students' responses were slightly above average, indicating that the VRLE system might not be exactly like the real world despite the fact that the VR environment seemed consistent with the real-world experience. Finally, for caption-related presence (Items 15-18), the results were mixed. While most students expressed higher involvement in the caption-on mode than the caption-off mode, the caption-off mode made the VRLE system more authentic in its representation of the real world. The overall results of the study revealed that the VRLE system created an immersive environment, since the students felt situated in the virtual setting. In addition, the students gained a sense of involvement in the VR-based learning tasks while interacting with the virtual character. Last but not the least, while the caption assistance led the students to be more deeply immersed in the virtual environment, the system without captions was perceived to be more realistic.

Table 4. Descriptive statistics of Igroup presence questionnaire

Subscale and questionnaire item	Mean
Overall feeling of presence (M = 5.27)	
1. In the computer-generated world I had a sense of "being there."	5.27
Spatial presence (M = 5.31)	
2. Somehow I felt that the virtual world surrounded me.	5.30
3. I felt like I was just perceiving pictures.	5.57
4. I did not feel present in the virtual space.	5.23
5. I had a sense of acting in the virtual space, rather than operating something from outside.	5.06
6. I felt present in the virtual space.	5.39
Involvement (M = 4.43)	
7. How aware were you of the real world surrounding while navigating in the virtual world? (i.e., sounds, room temperature, other people, etc.)	4.09
8. I was not aware of my real environment.	4.11
9. I still paid attention to the real world.	4.67
10. I was completely captivated by the virtual world.	4.84
Realness (M = 3.88)	
11. How real did the learning task seem to you?	3.59
12. How much did your experience in the virtual environment seem consistent with your real-world	4.44

experience?		
13.	How real did the virtual world seem to you?	3.7
14.	The virtual world seemed more realistic than the real world.	3.8
Caption-related presence (*M* = 4.48)		
15.	I am completely involved in the virtual world with captions.	4.94
16.	I am completely involved in the virtual world without captions.	3.99
17.	I feel like being in the real world when I situate the environment with captions.	4.26
18.	I feel like being in the real world when I situate the environment without captions.	4.72

4.3. RQ3: What were the learners' overall perceptions of the VRLE system?

The students' overall perceptions about the VR learning experience, collected via semi-structured interviews, were analyzed for identifying themes. Eight students volunteered for the interviews. The overall results revealed that the participants showed positive perceptions about the learning experience adopted in this study. Their responses highlighted their perceptions about the VRLE system in terms of realness, engagement, perspectives on caption assistance, and system recommendations. However, some students also directed the attention to concerns that should be taken into account while using the VRLE system for learning.

4.3.1. Realness in the VR learning experience

Most of the students expressed that they seemed to be truly inside the virtual world. Being able to move and take VR objects freely made the whole experience more realistic, enhancing their engagement in the VR system. In addition, the fact that the voice of the virtual character was recorded by a native English speaker created a sense of actually communicating with a real person. Related responses from the students were as follows:

- "I think it is quite real! When I moved too close to the cabinet, I felt like I was going to bump my head on it." (A1)
- "The things in VRLE are really realistic, but the movements of the clerk make it feel unreal because people in the real world won't act like that." (A4)
- "I think the clerk is real because her accent is not like a Taiwanese. I felt I was really talking to a foreigner." (A5)
- "I think the toys in VRLE are super real and I think it is cool that I could pick up items freely or throw away things in the virtual world." (A6)

However, some students also expressed their concerns while experiencing the VRLE system. Some students complained about experiencing discomfort in the VRLE system. One student even mentioned the feeling of "getting lost and disoriented," while another stated dizziness that prevented him from appropriately completing the task. A few students complained about challenges faced in grabbing the objects in the system, despite the time given for them to practice before actual experiment implementation.

4.3.2. Engagement in the VR learning

As the students felt a sense of realness from the VRLE system, their engagement in the VR system grew. Once the student felt engaged, learning took place naturally, as evidenced by the students' attentiveness to the learning tasks embedded in the VRLE system.

- "I felt like I really stayed inside and I concentrated on answering the questions." (A1)
- "I completely focused on the learning task! It is so rare that I listen to English so carefully!" (A7)

Similar to the issue of realness in the VR, some students noted their cautions with the use of VRLE system. One student mentioned the disturbance by the wire connected to the headset, making him "afraid of being tripped over." Some students, on the other hand, pointed out the anxiety of losing face in front of their classmates.

4.3.3. Perspectives on the caption

Some students preferred the caption-on mode, since they could cross verify their comprehension. To students who were still learning how to use English for daily communicative purposes (low-achieving students, in this study), the use of captions made them feel secured. On the other hand, some students were fonder of the caption-off mode, since it removed the visual distraction and thus created a more realistic setting.

- "I prefer to have the captions on since I can have a better understanding of the conversation. It was harder for me to understand what the clerk said without captions." (A1)
- "I like the caption option because I knew what the clerk was talking about; however, I think I can learn more without captions. It would push me to stay focused on the listening." (A7)
- "I like the captions. If I can't read the captions, I feel a bit lost. I need to double check my comprehension with the captions." (A4)
- "I prefer no captioning because it is more realistic. I can also listen to what the clerk said more attentively and that helps me learn better." (A2)
- "I like the no caption option, because the caption covered my sight and made me dizzy. No caption is more effective to me." (A3)
- "I think it's more effective to learn without captions because it is more like a real conversation! However, when it comes to breaking the record, the assistance of captions would be necessary." (A8)

Overall speaking, the students' preference for the caption assistance was mixed, with some favoring the caption-on mode while the others preferred the caption-off mode. For some students, the inclusion of the caption in the VRLE system made them feel secured as it provided extra linguistic support. To the others, the exclusion of the caption enhanced the sense of realness and authenticity in the VRLE system. Such results also echoed their responses of the caption-related presence subscale of the IPQ.

4.3.4. Recommendations for the system

While the students were positive about the use of VRLE in enhancing their communicative ability, suggestions were offered from the participants to improve the overall quality of the VR learning system. These recommendations included adding more stages or providing hints/rewards while using the system. Other comments to the systems were as follows:

- "I wish the playing area could've been bigger, such as walking outside to enter other stores." (A1)
- "I think there should be other people in the store—for example, asking other people questions or competing with other players." (A2)
- "I think it would be more realistic if I was able to see my own feet, or part of my body." (A3)
- "I wish that there was a reward mechanism so that players can collect points by answering questions and receive virtual money as a reward." (A5)
- "I think there should be a hint mechanism which allows you to get hints among the objects in the area, such as posters or TV. Otherwise it was quite annoying to get stuck on the same question." (A6)

Taken together, the students' suggestions on the VRLE system focused on more contents to be included, interaction with more avatars, improvement on the first-person physical appearance design, and inclusion of hints/rewards mechanism.

5. Discussion

The overall findings of the study showed that the VRLE system could provide the communication-facilitator affordances necessary to address the requirements in the academic literature for beneficial VR-supported language learning and of the more limited literature on VR for communicative purposes, particularly to EFL low-achieving learners. Specifically, the VR-supported design, using VRLE, contributed to significantly higher learning outcomes among those low-achieving students and most of them were positive about the VRLE system regarding spatial presence, involvement, and a sense of realness. They also found VRLE to be a beneficial tool that facilitated the communicative aspect of language learning, but their perceptions about the caption provision were more mixed.

5.1. Contextualized learning in VR to facilitate language learning

The results revealed significant differences in the growth of learners' communicative ability before and after using the VRLE system, potentially suggesting the facilitative role that the VRLE system played on the communicative ability of the low-achieving participants. The results were in line with the study of Legault et al. (2019) that less successful learners exhibited greater gains via immersive VR in second language learning. Further, students were not left alone to make the connection of language skills and applications, since the system itself provided an authentic immersive environment. It is not surprising that the students made improvement as the learning tasks embedded in the VRLE system reflected John Dewey's philosophy of learning by doing, indicating that the hands-on mission the students experienced in the virtual environment enabled them to interact with the system and to adapt as well as learn. As a high-immersion VR system that involved egocentric navigation rather than exocentric navigation commonly seen in low-immersion VR systems (Kozhevnikov & Dhond, 2012), the VRLE system offered a simulated real-life scenario for learners to test and apply language skills as a whole. It echoed the statement by Shu, Huang, Chang, and Chen (2019) that head-mounted display (such as the VRLE system adopted in this study) offered a greater sense of presence in the contextualized learning setting, indicating a positive potential for language learning. Unlike conventional spoken or written assessments where language skills of grammar, articulation, speaking, listening, reading and writing are tested as a detached skill, the learning system adopted in the study provided task-based assignments for the students and integrated communicative ability, thus making language learning holistic, rather than isolated aspects to be mastered separately (Robinson, 2011). Furthermore, by observing the performance of their classmates, the students in this study were given opportunities to observe and imitate behaviors of their peers, with which they tried to improve their learning outcomes.

5.2. Immersive learning through VR to attain engagement and lower level of anxiety

The goal of creating a sense of presence in the virtual world was achieved in this study, leading to an effective immersion experience for language acquisition among the students, aligning with the positive beliefs about immersion in language learning (see Paige, Jorstad, Siaya, Klein, & Colby, 2000 for a review of literature). In fact, this pedagogical approach aims for learners to maintain constant contact with the target language, which would be particularly beneficial to EFL learners who do not have easy access to the linguistic and cultural elements of the target language (Freina & Ott, 2015). Learning a second language (L2) through a real-life immersive environment, namely learning in the target culture where the language is spoken in real life, leads to lower interferences from a learner's native language to L2 and yields to higher proficiency compared with learning in a conventional classroom setting (Legault et al., 2019; Linck et al., 2009). Nevertheless, real-life immersion for various scenarios is not always accessible to every L2 learner, not to mention to the students in this experiment who are learning in a disadvantaged English learning environment. With the help of immersive VR technology, rendering capable the recreation of immersive learning settings, language learners are better surrounded with simulated environments that might not have been so easily accessible in the past. Furthermore, VR with HMD also enables a higher degree of embodiment in a virtual setting which proves to be conducive to L2 learning (Legault et al., 2019). The VRLE system adopted in this research offered learners a chance to simulate interactions in a real-life scenario. In addition, immersive learning offers language learners self-directed exploration rather than conventional spoon-fed and lecture-based instruction, which often disengages students (Delialioğlu, 2012). Accordingly, learners are empowered with the capability to self-direct learning, thus contributing to increased ownership of learning and engagement (Rashid & Asghar, 2016). Furthermore, the VR-supported learning in this study led to a lowered level of anxiety among its users, echoing the potential benefit of integrating VR into language learning as indicated by Cheng and Tsai (2019) and Marquess et al. (2017). To be more specific, learners tend to have lowered affective filters while interacting with virtual characters, because they know they are interacting with a machine where taking risks in language production is encouraged (Lee & Chen Hsieh, 2019; Lee, Lee, & Chen Hsieh, 2019; Reinders & Wattana, 2015). That is, VR-supported technology saves learners the embarrassment of making mistakes, hence increasing overall student engagement specifically in language production skills.

5.3. Caption-on vs. caption-off in language learning

The students' perceptions about the caption design in the VRLE system suggested that the inclusion of captions enabled them to be more involved in the VR learning, despite the fact that the exclusion of captions actually made

the learning experience more realistic. Previous studies have shown that supplying full captions or captions of target vocabulary in audio-visual materials has been an effective way to boost listening and reading comprehension of a second language (Hsu, Hwang, Chang, & Chang, 2013). The phenomenon of mixed feelings about captions might be explained by the sequence of the research design, with the caption-on mode played for the first round and then the caption-off mode for the second round. Learners were thus more acquainted with the interface, flow, tasks, etc. before experiencing the caption-off mode. Another potential reason, observed from the student interviews, is that captioning might sometimes distract the attention of users from their assigned tasks. While some students rely more on captions to cross-validate their comprehension, other students were immersed in the learning task and thus might perceive captions as a distraction, which potentially hindered the realness of the VR design.

6. Conclusion

The results of this study have extended prior research by probing into the under-explored issue of using virtual reality for communicative purposes in EFL learning, particularly regarding low-achieving junior high school students in a disadvantaged English learning environment. The primary affordances identified by this study were the beneficial applications of the VRLE system toward English communicative ability and sense of presence in an EFL context. Based on the findings and discussion of this study, the researchers offer the following conclusions and recommendations for practice.

- VR-supported instruction is an appropriate pedagogical design for teaching communicative aspects of English, since it aligns with modern ideas of student-centered active learning (Nouri, 2016), enables low-achieving learners to be immersed and motivated in learning tasks, and leads to beneficial outcomes.
- Because the effects of multimedia design on caption-on and caption-off modes were more mixed, instructors should take into consideration curricular goals and student needs. While the caption-on mode could increase student understanding of the materials, thus enhancing the level of involvement, the caption-on mode, on the other hand, might lower the realness of the virtual learning. Instructors are therefore advised to tailor the adoption of captioning to address different individual learning needs.

The present study not only provided empirical evidence for a VR-supported learning context among EFL low-achieving learners, but also shed light on the scenario of technology-enhanced, innovative pedagogies. Based on the results of this study, it is essential to conduct follow-up studies that would address the challenges raised in this study—that is, easy and affordable access to VR learning, and VR systems for more aspects of English learning. While VR-supported learning has been shown to be effective in this study, the high cost of the equipment makes it challenging to be widely adopted in classroom settings on a regular basis (McFaul & FitzGerald, 2020). Future design on VR learning systems, therefore, could combine VR with applications on smartphones to make VR learning more accessible. Furthermore, the VR system developed in the study focused on enhancing English communicative ability—namely, how to encourage students to apply their communicative skills purposefully in real-life scenarios where minor grammar mistakes may not affect comprehension. Therefore, it may not be the most appropriate model for other language skills such as grammar or writing practices. More VR systems are needed so that a more comprehensive understanding of how VR facilitates EFL learning can be achieved.

7. Final thoughts

The use of high-immersion VR in EFL contexts has been promising because VR is able to provide a near-authentic contextualized environment while also allowing for meaningful language engagement and promoting learner-centered approaches. In turn, this activates intrinsic motivation to lifelong language learning. The educational application of VR offers a whole new arena for language learners as it enables learners to be perceptually inside a scenario and to apply English skills virtually beyond the traditional classroom walls.

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