Investigaciones y Experiencias

Adoptando la RV en la sala de clases: Percepciones de futuros maestros bilingües y de ESL

Adopting VR in the Classroom: Perceptions of bilingual and ESL education pre-service teachers

Jorge F. Figueroa Flores[1]; Lisa Huffman[2]; Victor Lozada[3]; Emarely Rosa-Dávila[4]

[1] http://orcid.org/0000-0002-0276-5352 ; Texas Woman's University; jfigueroa2@twu.edu

[2] http://orcid.org/0000-0002-3409-4397; Texas Woman's University; lhuffman1@twu.edu

[3] http://orcid.org/0000-0001-7764-3467; Texas Woman's University; vlozada@twu.edu

[4] http://orcid.org/0000-0003-1831-1299; Texas Woman's University; erosadavila@twu.edu

Resumen: La realidad virtual (RV) es una tecnología inmersiva que está ganando impulso en la educación y ha llevado a nuevos enfoques de enseñanza. Además, ha disparado interés en los programas de preparación docente y especialmente en la formación de profesores bilingües y de ESL. Este artículo muestra un estudio cualitativo realizado con n = 27 futuros maestros bilingües y de ESL. El estudio buscó determinar la percepción de los futuros maestros bilingües y de ESL en principio con la RV y proporcionar una comprensión de las experiencias de las aplicaciones móviles de RV. todos los resultados fueron obtenidos a partir de reflexiones guiadas por futuros maestros inscritos en un curso de teorías de adquisición de segunda lengua para ESL y maestros bilingües en una universidad ubicada en el norte de Texas. Se realizó un análisis de contenido para analizar las reflexiones y se

---

[1] Texas Woman's University, Texas; jfigueroa2@twu.edu; http://orcid.org/0000-0002-0276-5352
[2] Texas Woman's University, Texas; lhuffman1@twu.edu; http://orcid.org/0000-0002-3409-4397
[3] Texas Woman's University, Texas; vlozada@twu.edu; http://orcid.org/0000-0001-7764-3467
[4] Texas Woman's University, Texas; erosadavila@twu.edu; http://orcid.org/0000-0003-1831-1299

determinaron tres categorías: fortalezas y limitaciones de la RV y aplicaciones móviles de RV. Los resultados revelaron una percepción positiva hacia las fortalezas de la RV con 60%, incluyendo que promueve el compromiso de los estudiantes (41%) y motiva a los estudiantes (29%). por otro lado, los futuros maestros percibieron las limitaciones de la RV, incluyendo los costos asociados (44%) y la capacidad de acceder a internet (31%). Finalmente, las aplicaciones que ofrecen viajes virtuales fueron percibidas para mejorar las experiencias de aprendizaje, incluyendo Google Expeditions (51%) y VR Tube (23%).

Palabras clave: realidad virtual, viajes virtuales, preparación docente, educación bilingüe/ESL

Abstract: Virtual reality (VR) is an immersive technology that is gaining momentum in education and has led to new teaching approaches. Moreover, it has spark interest in educator preparation programs and especially in the training of bilingual and ESL pre-service teachers. This article showcases a qualitative study conducted with n=27 undergraduate bilingual and ESL pre-service teachers. The study sought to determine the perception of bilingual and ESL pre-service teachers with VR and provide an understanding of VR mobile applications' experiences. All results were obtained from guided reflections made by pre-service teachers enrolled in the course theories of second language acquisition for ESL and bilingual teacher at a university located in north Texas. A content analysis was performed to analyze the reflections, and three categories were determined: strengths of VR, limitations of VR, and VR mobile applications. The findings revealed a positive perception towards the strengths of VR with 60%, including promotes student engagement (41%) and motivates students (29%). On the other hand, pre-service teachers perceived limitations of VR, including associated costs (44%) and the ability to access the internet (31%). Finally, VR mobile applications which offered VR tours were perceived to enhance learning experiences, including Google Expeditions (51%) and VR Tube (23%).

Key words: virtual reality, virtual tours, teacher education, bilingual/ESL education

Introduction

As the twenty-first century and the technological revolution continue, we find the educational system serving students from Generation Z and Generation Alpha. The members of these two generations are 100% digital natives (Prensky, 2010), meaning that they were born and raised in the age of digital technologies. To better serve them, education preparation programs are training pre-service teachers to adopt immersive technologies. These technologies provide new and fascinating experiences in simulated learning environments that merge the real world with the digital world (Blyth, 2018). As part of this group, we find virtual reality (VR), which refers to the computer technology that provides realistic environments in which users can interact with virtual objects to simulate the experience of interactions in the real world (Ghanbarzadeh et al., 2014).

Due to the opportunities VR presents for education, especially language learning, we believe it is necessary to train bilingual and ESL pre-service teachers on its use and application towards the teaching and learning process. However, research in this field is emerging. To date, studies that relate bilingual and ESL pre-service teacher training with VR use are limited. Huertas-Abril (2020) suggests that the opinions of pre-service teachers should be specifically studied to understand teacher and learner attitudes toward VR, especially in the context of ESL/EFL and bilingual education. This article showcases a qualitative study carried out with 27 bilingual and ESL pre-service teachers. It sought to determine the perception of bilingual and ESL pre-service teachers with VR and provide an understanding of VR mobile applications' experiences.Etiam a dignissim enim, eu tristique mauris. Nunc maximus lacus tortor, et venenatis neque faucibus in. Morbi et laoreet mi. Mauris non urna id dui pretium malesuada id nec leo. Praesent ipsum tortor, lacinia et diam quis, sollicitudin pellentesque ex. Nam porta lorem ipsum, in dignissim neque commodo in. Ut in magna enim. Maecenas vel dolor libero.

Virtual reality (VR) is an immersive technology that stands for its increased use in education (Huertas-Abril, 2020). VR refers to "computer-generated environments that simulate the physical presence of people or objects with realistic sensory experiences" (Johnson et al., 2016, p. 40). This technology enables users to immerse themselves into artificial worlds through a VR viewer or headset. It provides simulated real-environment scenes to interact with virtual objects (Chien et al., 2020; Ghanbarzadeh et al., 2014).

To better understand VR, it requires an insight into its types: (1) fully immersive VR, (2) non-immersive/ desktop VR, and (3) Videos and 360-degree pictures (Maas & Hughes, 2020). Fully immersive VR involves the use of a head-mounted display, connected to or comprising a computer which allows the user to physically move or use a joystick to control movement within a 3D virtual environment (Lee & Wong, 2014; Southgate et al., 2016). Non-immersive/desktop VR involves accessing a virtual environment, 360-degree images/videos, or other 3D environments using a desktop computer and a monitor with peripherals such as a joystick, mouse, or gloves to control movement and explore (Lee & Wong, 2014). Videos and 360-degree pictures refer to images or videos taken by using technology such as a camera or multiple cameras that capture the entire 360-panoramic degree view of the location (Maas & Hughes, 2020).

 A once costly technology, VR has become cheaper, more accessible, and available for general use in recent years. It has led to broader adoption in all settings, including education (Bonner & Reinders, 2018). Two crucial aspects have been the evolution of the smartphone, which permits easy access to VR content (Ralph, 2015), and the development of low-cost VR headsets (Aznar-Díaz et al., 2018; Huertas-Abril, 2020). For example, smartphones are equipped and ready to download VR mobile apps, allowing students to experience 360-degree images and videos with low-cost viewers (Ralph, 2015). Furthermore, according to the Alexander and colleagues (2019), the most basic smartphone can be paired with an inexpensive Google Cardboard headset to create an immersive experience. This pairing has provided new meaningful and experiential teaching and learning experiences by breaking the barriers of space and time and exploring concepts in

new ways. Most of all, it has provided a low-cost alternative for PK-12 schools and universities to adopt VR, making it a feasible learning tool. For many students, smartphones are the primary way to interact with learning materials, with over 80% of K-12 (McFarland et al., 2017) and over 95% of undergraduate university students either owning a smartphone (Alexander et al., 2019) or having access to smartphones or tablets (Dahlstrom & Bichsel, 2014).

Another example is the technological advances of standalone VR headsets, making them more affordable (Martín-Gutiérrez et al., 2017). These untethered wireless devices (e.g., Oculus Go, Oculus Quest II, HTC Vive) do not require a smartphone or a computer to deliver a VR experience because they are equipped with a built-in processor, GPU sensors, battery, memory, and displays. As a result, according to Aniwaa team (2021), standalone VR headsets offer a more robust and immersive experience.

VR quickly evolves the many ways reality can be experienced (Mann et al., 2018) and provides opportunities to enhance the teaching and learning process. According to Otero & Flores (2011), it (i) facilitates constructivist learning; (ii) provides alternative learning experiences; and (iii) fosters peer collaboration beyond classroom walls. Huertas-Abril (2020) and Marín-Díaz, Sampedro and Vega (2022) mentions that these characteristics align with a student-centered teaching approach that promotes active and experiential learning. Additionally, Chen (2016) indicates that VR can help develop more complex and higher-order thinking when applied with a proper learning design.

According to Lege & Bonner (2020), the adoption of VR is motivating and exciting for students. It increases students' learning motivation and stimulates participants' interest and engagement with the subject matter (Costa & Melotti, 2012; Makransky & Lilleholt, 2018). It has been successfully adopted in medical education for more than a decade and integrated into specialized courses like radiology (Gunn et al., 2017). Contemporarily, medical students can practice their surgical skills in safe environments, including procedures like laparoscopy (Huber et al., 2015) and temporal bone surgery (Fang et al., 2014). Other successful applications have included combining high-level chemistry courses with VR to enhance students' scientific skills (Hodges et al., 2018), infusing VR and physics to improve students' learning achievement, motivation, and autonomy (Civelek et al., 2014), and implementing VR field trips (VFTs) as a classroom activity to support social studies, history, science, and language/arts (Kenna & Potter, 2018). VFTs allow students to witness historical events, visit faraway lands, and learn about global issues. Finally, the immersion provided by VR becomes the motivational factor that keeps students happier, more excited, and less bored (Kavanagh et al., 2017; Parong & Meyer, 2018).

VR is recognized as a potential approach for language learning as it provides an opportunity to manage the lack of language acquisition and social presence (Chien et al., 2020). It gives a realistic experience to emergent bilinguals where they interact with virtual characters or objects that greatly enhance their learning achievement (Yang et al., 2010). Besides, it empowers language educators with the tools to meet educational objectives that can't be

completed satisfactorily within the constraints imposed by the current physical location (Lege & Bonner, 2020).

Recently, researchers have identified several advantages of using VR with emergent bilinguals, such as practicing their skills without time and space limitations and recording the learning process for further analysis (Chien et al., 2020; Ghanbarzadeh et al., 2014). Another study found that VR increases the engagement, motivation, active learning, and creativity of emergent bilinguals by providing them more opportunities to interact with meaningful contexts (Chen, 2016). In addition, Hassani and colleagues (2016) found that applying VR to improve the English speaking and listening skills of emergent bilinguals was effective and reduced their grammatical mistakes and pronunciation hesitation. Finally, other studies have found promising results in the use of VR to support vocabulary learning and retention (Alfadil, 2017; Madini & Alshaikhi, 2017; Tai et al., 2020).

Method

This study was designed to perform a qualitative analysis using Patton's (2003) Qualitative Evaluation Checklist. According to Denzin and Lincoln (2017), the primary purpose of a qualitative study is to examine the participants' opinions and experiences to understand and interpret the phenomena according to the meaning that the participants attach to them. Grounded Theory (Glaser & Strauss, 1967) was used to approach the phenomenon and disclose a theory from the collected data (Pidgeon, & Henwood, 1997). We adopted Grounded Theory to determine categories based on the participants' collected data regarding VR for the bilingual and ESL classroom. Following this framework, we incorporated the research stages, from constructing research questions to data collection and analysis.

The study sought to determine the perception of bilingual and ESL pre-service teachers with VR for the classroom and provide an understanding of VR mobile applications' experiences. Three structured study questions with identical terminology were given to all the pre-service teachers, which guaranteed that all results were comparable (Bogdan & Taylor, 1975). The study questions were:

RQ1: What are the strengths of integrating VR in the bilingual and ESL classroom?

RQ2: What are the limitations of integrating VR in the bilingual and ESL classroom?

RQ3: Which VR mobile apps would you integrate in the bilingual and ESL classroom?

A purposive sample was used for the selection of the participants (n = 27). All results were obtained from guided reflections made by undergraduate bilingual and ESL pre-service teachers enrolled in the course Theories of Second Language Acquisition for ESL and Bilingual Teachers at a higher education institution in north Texas. Ninety-six percent of the pre-service teachers identified themselves as female, while 4 % identified themselves as males. Fifty-Five percent of the participants pursued and ESL certification, while 35% pursued a bilingual certification, and 10% a triple certification.

The eligibility criteria were based on proximity and participation in a six-hour specialized classroom training with the use of VR for education. In addition, all participants were

selected through criterion referenced sampling technique (Mertens, 2014). For the training, pre-service teachers were provided with Google Cardboard Headsets and permitted to use their smartphones. During the six-hour training, students were engaged in the use of VR and how to integrate mobile applications to education. As part of the training, students explored mobile VR applications along with its potential alignment with state standards for the bilingual and ESL classroom. Additionally, this training was supplemented with online resources, which included videos, online tutorials, and Internet links.

This study followed an exploratory design and used a qualitative method. The theoretical framework was based on Grounded Theory (Glaser & Strauss, 1967), which sets out to discover or construct theory from data, systematically obtained, and analyzed using comparative analysis (Chun Tie et al., 2019). A three question, open-ended instrument was administered and used guided reflections. Upon six hours of specialized training with the use of VR for education, all participants were given a worksheet with the study questions on which to reflect. The categories were classified into: (i) strengths of VR, (ii) limitations of VR, and (iii) VR mobile applications. After the data was collected, the answers were coded, and content analysis was performed to analyze the reflections. This type of analysis is a systematic reading of a body of texts, images, and symbolic matter, not necessarily from an author's or user's perspective (Krippendorf, 2004). All responses were coded and gathered by category using NVivo Plus 12 for Windows.

Results

The present study aimed to understand the perceptions of virtual reality (VR) among bilingual and ESL pre-service teachers. From the data, a total of 328 coded items revealed the categories of strengths of VR, limitations of VR, and VR mobile apps. The specific details are presented in Table 1.

Table 1. Coding Categories. Source: self made.

Codes	Participants	Coded items	%
Strengths of VR	27	195	60%
Limitations of VR	27	80	24%
VR mobile apps	27	53	16%

To answer the first research question, a total of 195 items were coded regarding the strengths of integrating VR in the bilingual and ESL classroom. The bilingual and ESL pre-service teachers highlighted the following strengths: (i) VR promotes student engagement was 41% (80), (ii) motivates students was 29% (57), (iii) an inclusive technology was 18% (35), and (iv) provides outstanding visuals for students was 12% (23) as seen in Table 2.

Table 2. Perceived Strengths of VR. Source: self made.

	Coded items	%
Student engagement	80	41%
Motivates students	57	29%
Inclusive technology	35	18%

Outstanding visuals	23	12%

Preservice teacher positively noted how student engagement would increase student engagement as Participant 8 noted, "I'm positive that student engagement is a strength in VR. The learners will be focused on what they are watching. Most of all they won't consider it as part of their class." Participant 17 connected student engagement with the ability to motivate students regardless of their language background, "Students will be completely engaged. The concepts will be perceived in a different way. It will motivate the students. This is to be geared up to students no matter the language."

Emergent bilingual students, through greater engagement, can become more motivated to learn through the use of VR. Participant 5 noted how "ELLs will be more involved with subject matter [because]they will be actively taking control of their learning." In addition to how Participant 17 connected student engagement and motivation (see above), Participant 20 used this positive outlook of the use of VR in the multilingual classroom to show their enthusiasm for applying it in their future classroom, "I see many strengths for VR in the bilingual and ESL classroom. The biggest two are student engagement and motivation…I can't wait to use it in my classroom."

In addition to student engagement and motivation, student interest, especially in regard to the visuals were perceived as a strength to VR teaching in a bilingual setting as Participant 2 noted, "A strength for using VR in the bilingual or ESL classroom, I would say is the engagement, interest, and motivation it can give students to be more willing to learn." Participant 8 specifically noted how "the visuals are out of this world." These comments show how student engagement, motivation, and interest are intertwined in the immersive experiences afforded by teaching with VR. Even though these experiences seem to be targeted for emergent bilinguals, other student populations could also benefit.

The inclusive nature of teaching with VR was an important theme noted by the participants. One of the populations that could benefit from inclusivity is students with disabilities. Participant 8 noticed that "VR provides an opportunity to students with special needs to participate as well. It's all about inclusion." Even though the pre-service teachers offered connections to the benefits for emergent bilingual students and students with disabilities, Participant 3 recalled how "VR is a scaffold for learning" and Participant 4 saw how VR could provide "a scaffold to learning."

Even though the bilingual and ESL pre-service teachers noticed many advantages to using VR with teaching such as promoting student engagement, motivating students, being an inclusive technology, and providing outstanding visuals for students, the limitations of using the technology also factored into their perceptions of using VR in the classroom.

To answer the second research question, a total of 80 items were coded about the limitations of integrating VR in the bilingual and ESL classroom. Data analysis indicated that the following limitations were the most prevalent themes among bilingual and ESL preservice teachers: (i) costs were perceived as the primary limitation with 44% (35), (ii) the ability to access the internet with 31% (25), (iii) time for teacher training with 15% (12), and (iv) the lack of multilingual content 10 % (8) as seen in Table 3.

Table 3. Perceived Limitations of VR. Source: self made.

	Coded items	%
Costs	35	44%
Ability to access the internet	25	31%
Time for teaching training	12	15%
Lack of multilingual content	8	10%

Many participants perceived the high costs of the technology equipment or access to the internet as primary issues for their future students as Participant 1 observed, "the cost of this technology and internet access is a limitation for school districts. Not every school district has the tools or the money." Participant 2 saw a limitation of VR "could be the costs and access to equipment." In conjunction to the costs and access to the internet, Participant 6 recognized that "the limitations would be the costs for schools, the access to the internet and…the time and knowledge necessary for the teacher to integrate it."

The lack of time for training teachers to appropriately integrate VR into their curricula was perceived as another limitation to VR. Participant 14 anticipated that "teachers need time for training with this technology. Most teachers don't have the time to add new things to their agendas." While some participants understood the time for training teachers on how to use the technology would be an issue, Participant 5 took the idea further by acknowledging that "teachers might not have the time to learn how to integrate the technology."

Because our participants were bilingual and ESL preservice teachers, it makes sense that they would perceive the lack of multilingual content as an issue. Participant 4 expressed this perception as VR "not [having] enough experiences in languages other than English." Participant 26 extended this idea to multilingualism and using the home language as an asset: "There is not enough multilingual content. It prevents ELLs of exploring VR in their home language."

To answer the last research question about which VR mobile apps would the participants integrate into their bilingual and ESL classrooms, 53 items were coded. Based on the reflections from the participants, the following applications were suggested: (i) Google Expeditions with 51% (27), (ii) VR Tube with 23% (12), (iii) Nearpod VR with 15% (8), and (iv) Google Arts and Culture with 11% (6) as seen in Table 4.

Table 4. VR Mobiles Apps. Source: self made.

	Coded items	%
Google Expeditions	27	51%
VR Tube	12	23%
Nearpod VR	8	15%
Google Arts and Culture	6	11%

In regard to Google Expeditions, Participant 1 said, "I would definitely use Google Expeditions. With this application my students will have the opportunity to travel the world, visit cities, explore continents, and learn about cultures. While Google Expeditions was the most mentioned application, Participant 6 contrasted Google Expeditions with VR Tube: "I loved Google Expeditions, but I see more opportunities for VR Tube because of the easy

access to videos. Loved it!" Additionally, Participant 5 saw the curricular applications of "using Nearpod VR as a tool to learn content and vocabulary." Lastly, Participant 8 noted how both Google Expeditions and Google Arts and Culture were specifically situated for taking virtual field trips, "I think virtual reality is a great new tool for the classroom! I think it would be a good idea to travel to different countries and learn about different cultures with the VR apps Google Expeditions and Google Arts and Culture."

The use of multiple applications in the classroom was not limited to Google Expeditions and Google Arts and Culture. Participant 4 saw the creative possibilities that a student could use when applying multiple applications: "I would use Google Expeditions, VR Tube, and Nearpod VR in my classroom. I feel they offer a lot for every learner. Activities to create with this app are endless. You can use a pre-made one, the student can create one, or you the teacher can create one".

Finally, Participant 18 connected certain VR applications with strengths of using VR in teaching bilingual and ESL students and specific curricular applications: "I think the Google Expeditions and Nearpod app are a great way to keep students engaged in learning while having fun. I like how both apps takes you on virtual tours to explore different things and places. I think I would use these apps for history or science subjects".

Conclusions

To answer the first research question pertaining to the strengths of VR, the perceptions of the bilingual and ESL pre-service teachers are aligned with the findings on previous research, especially with the increase of student engagement and motivation (Costa & Melotti, 2012; Lege & Bonner, 2020, Marín-Díaz et al, 2022). Once emergent bilinguals are engaged and motivated academic performance improves (Brown, 2014; Mahdikhani & Rezaei, 2015). This is also supported by Symonenko and colleagues (2020), VR solves the problem of immersion in language environments by motivating the student to use existing skills and knowledge to demonstrate real life circumstances. Another strength perceived by bilingual and ESL pre-service teachers participating in the study included VR as an inclusive technology. Studies have found the potential of VR to work with special needs students in the areas of intellectual disabilities and autism (Maskey et al., 2014; Marín-Díaz, 2017a and b). Some of these VR experiences focused on creating safe spaces, preparing for transitions, and developing social skills. In addition, Lege and Bonner (2020) mentioned the vast amount of VR experiences available for empathy training. These experiences also support culturally relevant and sustaining teaching principles which are necessary for all pre-service teachers to learn.

For research question two, the limitations of VR provided findings that compare and contrast with recent research. The first two limitations perceived by the bilingual and ESL pre-service teachers are costs associated to VR and access to the internet. This limitation has been brought by previous studies which mentioned that many schools could not implement VR applications and students did not have access because of high costs (Yang et al., 2010). On the other hand, recent studies found VR to be currently a low-cost and affordable technology (Chien et al., 2020; Ralph, 2015; Marín-Díaz, 2017a and b). However, it is important to realize that not every school district or student will have the funding or internet requirements to carry out VR. Both limitations perceived by pre-service teachers open the discussion for further research on the digital divide. According to Tate (2021), the digital divide has narrowed, but 12 million students are still disconnected. Another limitation

perceived was time for teacher training. As with every new technology that is adopted, teachers will require training for curriculum alignment and implementation. The time devoted to teaching training will depend on the workforce culture (Velev & Zlateva, 2017). It is difficult and time consuming for educators to design VR teaching materials. Finally, the lack of multilingual content for VR was perceived as a limitation. Currently, most of the VR content available is in English. Not having access to multilingual content might decrease the level of motivation of emergent bilinguals (García & Kleyn, 2016).

To answer research question three, bilingual and ESL pre-service teachers expressed predilection for four mobile apps: Google Expeditions, VR Tube, Nearpod, and Google Arts & Culture. These apps offer VR tours which support the teaching and learning experience. Also, each offer educational content that can easily be align with state standards. All the apps mentioned are low cost and easy to implement (Chien et al., 2020). VR tours provide the opportunity for emerging bilinguals to visit their home culture and share it with the rest of the students, which supports culturally relevant pedagogy. Adopting these VR apps and aligning their content could enhance and support culturally relevant teaching (Brown et al., 2020).

Lastly, this article presented the perceptions of bilingual and ESL pre-service teachers with the use of VR, which illustrated strengths, limitations, and recommended VR mobile apps. It must be considered that the bilingual and ESL pre-service teachers identified more strengths (60%) than limitations (24%) in the use of VR. Based on the findings, it is recommended that educator preparation programs provide training opportunities for pre-service teachers to engage with VR. Additionally, as this technology continues to evolve, more research is necessary such as dealing with the digital divide. It is important that educator preparation program adapt changes to their curricula to move from mobile VR to fully immersive VR, to teaching programming for VR, and to train pre-service teachers how to create VR multi-lingual and multi-cultural materials.

Conflict of Interest

The authors declare no conflict of interest

References

ALEXANDER, B., ASHFORD-ROWE, K., BARAJAS-MURPHY, N., DOBBIN, G., KNOTT, J., MCCORMACK, M., POMERANTZ, J., SEILHAMER, R. & WEBER, N. (2019). Educause. https://library.educause.edu/-/media/files/library/2019/4/2019horizonreport.pdf

AZNAR-DÍAZ. I., ROMERO-RODRÍGUEZ, J.M. & RODRÍGUEZ GARCÍA, A.M. (2018). La tecnología móvil de realidad virtual en educación: Una revisión del estado de la literatura científica en España. *EDMETIC, Revista de Educación Mediática y TIC*, 7(1), 256–274. https://doi.org/10.21071/edmetic.v7i1.10139

ALFADIL, M. M. (2017). *Virtual reality game classroom implementation: Teacher perspectives and student learning outcomes* [Doctoral thesis, University of Northern Colorado]. Scholarship & Creative Works @ Digital UNC. https://digscholarship.unco.edu/dissertations/408/

ANIWAA TEAM. (2021, January 12). *The best all-in-one VR headsets of 2021 (standaloneVR).* https://www.aniwaa.com/buyers-guide/vr-ar/best-standalone-vr-headset/

BLYTH C. (2018). Immersive technologies and language learning. Foreign Language Annals, 51(1), 225–232. https://doi.org/10.1111/flan.12327

BOGDAN, R. & TAYLOR, S. J. (1975). *Introduction to Qualitative Research.* John Wiley

BONNER, E. & REINDERS, H. (2018). Augmented and virtual reality in the language classroom: Practical ideas. *The Journal of Teaching English with Technology*, 18(3), 33–53.

BROWN, H. D. (2014). *Principles of language learning and teaching* (6th ed.). Pearson.

CHEN, J. C. C. (2016). The crossroads of English language learners, task-based instruction, and 3D multi-user virtual learning in Second Life. *Computers & Education*, 102, 152–171. https://doi.org/10.1016/j.compedu.2016.08.004

CHIEN, S. Y., HWANG, G. J. & JONG, M. S. Y. (2020). Effects of peer assessment within the context of spherical video-based virtual reality on EFL students' English Speaking performance and learning perceptions. Computers & Education, 146. https://doi.org/10.1016/j.compedu.2019.103751.

CHUN TIE, Y., BIRKS, M. & FRANCIS, K. (2019) Grounded theory research: A design framework for novice researchers. *SAGE Open Medicine.* https://doi.org/10.1177/2050312118822927

CIVELEK, T., UCAR, E., USTUNEL, H. & AYDIN, M. K. (2014). Effects of a haptic augmented simulation on K-12 students' achievement and their attitudes towards physics. *Eurasia Journal of Mathematics, Science and Technology Education*, 10(6), 565–574. https://doi.org/10.12973/eurasia.2014.1122a

COSTA, N. & MELOTTI, M. (2012). Digital media in archaeological areas, virtual reality, authenticity and hyper-tourist gaze. *Sociology Mind*, 2(1), 53–60. https://doi.org/10.4236/sm.2012.21007

DAHLSTROM, E. & BICHSEL, J. (2014). *ECAR Study of Undergraduate Students and Information Technology, 2014.* https://library.educause.edu/resources/2014/10/study-of-students-and-information-technology-2014

DENZIN, N. K. & LINCOLN, Y. S. (Eds.). (2017). *The SAGE Handbook of Qualitative Research* (5th ed.). SAGE.

FANG, T.-Y., WANG, P.-C., LIU, C.-H., SU, M.-C. & YEH, S.-C. (2014). Evaluation of a haptics-based virtual reality temporal bone simulator for anatomy and surgery training. *Computer Methods and Programs in Biomedicine*, 113(2), 674–681. https://doi.org/10.1016/j.cmpb.2013.11.005

GARCIA, O. & KLEYN, T. (Eds.). (2016). *Translanguaging with multilingual students: Learning from classroom moments*. Routledge.

GHANBARZADEH, R., GHAPANCHI, A. H., BLUMENSTEIN, M. & TALAEI-KHOEI, A. (2014). A decade of research on the use of three-dimensional virtual worlds in health care: A systematic literature review. *Journal of Medical Internet Research*, 16(2). https://doi.org/10.2196/jmir.3097

GLASER, B. G. & STRAUSS, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Aldine.

GUNN, T., JONES, L., BRIDGE, P., ROWNTREE, P. & NISSEN, L. (2017). The use of virtual reality simulation to improve technical skill in the undergraduate medical imaging student. *Interactive Learning Environments*, 5, 613–320.https://doi.org/10.1080/10494820.2017.1374981

HASSANI, K., NAHVI, A. & AHMADI, A. (2016). Design and implementation of an intelligent virtual environment for improving speaking and listening skills. *Interactive Learning Environments*, 24(1), 252–271. https://doi.org/10.1080/10494820.2013.846265

HODGES, G. W., WANG, L., LEE, J., COHEN, A. & JANG, Y. (2018). An exploratory study of blending the virtual world and the laboratory experience in secondary chemistry classrooms. *Computers & Education*, 122, 179–193. https://doi.org/10.1016/j.compedu.2018.03.003

HUBER, T., PASCHOLD, M., LANG, H. & KNEIST, W. (2015). Influence of camera navigation training on team performance in virtual reality laparoscopy. *Journal of Surgical Simulation*, 2, 35–39. https://doi.org/10.1102/2051-7726.2015.0008

HUERTAS-ABRIL, C. (2020). El potencial del uso de la realidad virtual para la enseñanza del inglés como lengua extranjera y la educación bilingüe en educación primaria. In R.

Roig-Vila (Ed.), *La docencia en la enseñanza superior. Nuevas aportaciones desde la investigación e innovación educativas* (pp. 1225–1235). Editorial Octaedro.

JOHNSON, L., ADAMS BECKER, S., CUMMINS, M., ESTRADA, V., FREEMAN, A. & HALL, C. (2016). *NMC horizon report: 2016 higher education edition*. New Media Consortium. https://library.educause.edu/-/media/files/library/2016/2/hr2016.pdf

KAVANAGH, S. LUXTON-REILLY, A., WUENSCHE, B., & PLIMMER, B. (2017). A systematic review of virtual reality in education. *Themes in Science and Technology Education*, *10*(2), 85–119. https://www.learntechlib.org/p/182115/

KENNA, J. L. & POTTER, S. (2018). Experiencing the world from inside the classroom: Using virtual field trips to enhance social studies instruction. *The Social Studies*, *109*(5), 265–275. https://doi.org/10.1080/00377996.2018.1515719

KRIPPENDORFF, K. (2004). *Content analysis: An introduction to its methodology* (2nd ed.). SAGE.

LEE, E. A. & WONG, K. W. (2014). Learning with desktop virtual reality: Low spatial ability learners are more positively affected. *Computers & Education*, *79*, 49–58. https://doi.org/10.1016/j.compedu.2014.07.010

LEGE, R. & BONNER, E. (2020). Virtual reality in education: The promise, progress, and challenge. *The JALT CALL Journal*, *16*(3), 167–180. https://doi.org/10.29140/jaltcall.v16n3.388

MAAS, M. J. & HUGHES, J. M. (2020) Virtual, augmented and mixed reality in K–12 education: A review of the literature. *Technology, Pedagogy and Education*, *29*(2), 231–249. https://doi.org/10.1080/1475939X.2020.1737210

MADINI, A. A. & ALSHAIKHI, D. (2017). Virtual reality for teaching ESP vocabulary: A myth or a possibility. *International Journal of English Language Education*, *5*(2), 111–126. https://doi.org/10.5296/ijele.v5i2.11993

MAKRANSKY, G., TERKILDSEN, T. S. & MAYER, R. E. (2019). Adding immersive virtual reality to a science lab simulation causes more presence but less learning. *Learning and Instruction*, *60*, 225–236. https://doi.org/10.1016/j.learninstruc.2017.12.007

MANN, S., FURNESS, T., YUAN, Y., IORIO, J. & WANG, Z. (2018, April 20). *All reality: Virtual, augmented, mixed (X), mediated (X, Y), and multimediated reality*. https://arxiv.org/abs/1804.8386

MARÍN DÍAZ, V. (2017a). The relationships between Augmented Reality and inclusive education in Higher Education. *Bordón*, *69*(3). 125-142. https://doi.org/10.13042/Bordon.2017.51123

MARÍN-DÍAZ, V. (2017b). The Augmented Reality in the educational sphere of student of degree in childhood education. Case study. *Pixel Bit, Revista de Medios y educación, 51*, 9-24. http://dx.doi.org/10.12795/pixelbit.2017.i51.01

MARÍN-DÍAZ, V., SAMPEDRO, B.B. & VEGA, E. (2022). La realidad virtual y aumentada en el aula de secundaria. *Campus Virtuales, 11*(1), 225-236. https://doi.org/10.54988/cv.2022.1.1030

MARTÍN-GUTIÉRREZ, J., MORA, C. E., AÑORBE-DÍAZ, B. & GONZÁLEZ-MARRERO, A. (2017). Virtual technologies trends in education. *EURASIA Journal of Mathematics, Science and Technology Education, 13*(2), 469–486. https://doi.org/10.12973/eurasia.2017.00626a

MASKEY, M., LOWRY, J., RIDGERS, J., MCCONACHE, H. & PARR, J. R. (2014). Reducing specific phobia/fear in young people with autism spectrum disorders (ASDs) through a virtual reality environment. *PLoS One, 9*(7), https://doi.org/10.1371/journal.pone.0100374

MCFARLAND, J., HUSSAR, B., DE BREY, C., SNYDER, T., WANG, X., WILKINSON-FLICKER, S., GEBREKRISTOS, S., ZHANG, J., RATHBUN, A., BARMER, A., BULLOCK MANN, F. & HINZ, S. (2017). *The Condition of Education 2017* (NCES 2017-144). National Center for Education Statistics. https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2017144

OTERO FRANCO, A. & FLORES GONZÁLEZ, J. (2011). Realidad virtual: Un medio de comunicación de contenidos. Aplicación como herramienta educativa y factores de diseño e implantación en museos y espacios públicos. *Revista de Comunicación Audiovisual y Nuevas Tecnologías, 9*(2), 185–211. https://doi.org/10.7195/ri14.v9i2.28

PARONG, J. & MAYER, R. E. (2018). Learning science in immersive virtual reality. *Journal of Educational Psychology, 110*(6), 785–797. https://doi.org/10.1037/edu0000241

PATTON, M. Q. (2003). *Qualitative Evaluation Checklist*. Evaluation Checklists Project. https://bit.ly/2DSPDvn

PIDGEON, N. & HENWOOD, K. (1997). Using grounded theory in psychological research. In N. Hayes (Ed.), *Doing Qualitative Analysis in Psychology* (pp. 245–273). Psychology Press.

PRENSKY, M. (2010). *Teaching digital natives: Partnering for real learning*. Corwin.

RALPH, N. (2015, JULY 2). *These headsets promise a taste of VR without breaking the bank. CNET*. https://www.cnet.com/news/these-headsets-promise-a-taste-of-vr-without-breaking-the-bank/

SYMONENKO, S. V., ZAITSEVA, N. V., OSADCHYI, V. V., OSADCHA, K. P. & SHMELTSER, E. O. (2020). Virtual reality in foreign language training at higher education institutions. *CEUR Workshop Proceedings, 2547*, 36–49. http://ceur-ws.org/Vol-2547/paper03.pdf

TAI, T. Y., CHEN, H. H. J. & TODD, G. (2020). The impact of a virtual reality app on adolescent EFL learners' vocabulary learning. *Computer Assisted Language Learning.* https://doi.org/10.1080/09588221.2020.1752735

TATE, E. (2021, JANUARY 27). *The digital divide has narrowed, but 12 million students are still disconnected.* EdSurge. https://www.edsurge.com/news/2021-01-27-the-digital-divide-has-narrowed-but-12-million-students-are-still-disconnected

VELEV, D. & ZLATEVA, P. (2017). Virtual reality challenges in education and training. International *Journal of Learning and Teaching, 3*(1), 33–37. https://doi.org/10.18178/ijlt.3.1.33-37

YANG, J. C., CHEN, C. H. & JENG, M. C. (2010). Integrating video-capture virtual reality technology into a physically interactive learning environment for English learning. *Computers & Education, 55*(3), 1346–1356. https://doi.org/10.1016/j.compedu.2010.06.005