Editorial: virtual reality through the lens of educators

Charles Xiaoxue Wang* and
Michele Garabedian Stork

College of Education,
Florida Gulf Coast University,
Fort Myers, FL 33965, USA
Email: xxwang@fgcu.edu
Email: mistork@fgcu.edu
*Corresponding author

We all have witnessed the great impacts of technology on learning and instruction, especially in the last decade when many smart technologies began to be infused in education. In recent years and among many smart technologies applied for learning, Virtual Reality (VR) has certainly become one of the most popular. In this Special Issue with the theme "Virtual Reality to Support Learning", we define VR as any technology that provides its users an interactive computer-generated experience through text, audio, visual, spatial and/or speed messages within a simulated environment that engages its users in multi-sensory interactions and reactions for learning. By this definition Augmented Reality (AR), Mixed Reality (MR), or Hybrid Reality (HR) were included in the call for manuscripts.

This definition of VR also reflects its functionality when seamlessly integrated for learning, training, and classroom instruction. In general, VR affords us with the following:

- VR affords different communication methods including those in text, image, audio and video formats (Wang et al., 2009).
- VR affords consistent and stable immersive learning environments that can be repeatedly used according to individual learning needs (Scoresby and Shelton, 2011).
- VR affords unique 3D social and physical presence that promotes interactions in situated learning and experiential learning (Dawley and Dede, 2014).
- VR affords unique learning experience through a 3D simulated learning environment that avoids risks and dangers existing in realistic environments for learning (Tichon and Burgess-Limerick, 2011).
- VR, especially AR and MR, affords enhanced presentation of information that assists VR users with detailed explorations of the problems and enables them to offer solutions from multiple perspectives (Aqlan et al., 2020; Hwang and Hu, 2013; Kim et al., 2011; Shi et al., 2020).

With these great VR functionalities, "Virtual Reality to support learning" becomes real.

Another anchor point discussed multiple times before creating the call for manuscripts was "learning." As professional educators and educational researchers, we believe one important task of our mission is to help learners become successful through learning, both professionally and in their personal lives. It is our hope that through this special issue, we could highlight how VR is applied to support learning including its new developments and related issues in the field of education. While we emphasise VR to support learning, we want to clearly express our intention that we do not view VR as a tool external to learning, which might be dragged into the classic debate of media (Becker, 2010). We believe VR is an integral part of learning itself when it is appropriately utilised. From the view point of Constructivism (Piaget, 1971), learners construct the knowledge through their own experiences and their experiences in VR are just one of those responsible for learning and knowledge construction. In this sense, "Virtual Reality to support learning" focuses on exploring on how VR can be effectively used.

Many visionary scholars have made tremendous efforts to explore and to understand VR and its applications. In early 1990s, VR was typically defined as "three-dimensional, simulated alternate worlds or realities that are enabled through real-time animation generated by a computer and controlled by a user with a stereoscopic head-mounted display (HMD) and wired gloves or position tracking software and hardware (Coates, 1992; Greenbaum, 1992; Krueger, 1991)" (Virtual Reality, n.d.). These scholars primarily defined VR in terms of technological hardware including computers, head-mounted displays, and other technology related devices such as motion-sensing gloves. However, Steuer created "a new, variable-based definition of virtual reality that can be used to classify virtual reality in relation to other media" (1992, p.73). The definition was based on concepts of "presence" and "telepresence," the sense of being in an environment, created by natural or mediated means. This definition of VR shifted from technological perspective to the experiential one which reflected the nature of VR based on users' experiences including user presence and interactivity. This new definition helped diffuse VR into different fields such as engineering, medicine, and, most importantly to us, education.

Since then, the exploration of VR for learning and instruction gradually increased as reflected in publications. A few quick snapshots of VR from recent journal publications (2015–2019) help us to get a sense of VR development in literature. We searched for the information on VR publications in the Web of Science Database, which has access to multiple databases with comprehensive citation data. We used advanced search for "Virtual Reality" in the title with "document types = articles" and then added different fields of study to see how VR literature was published in different fields from 2015–2019. Table 1 displays the search results.

In the past five years (2015–2019), articles with VR in their titles were mostly published in the fields of Engineering (857), Education (658), and Medicine (351). The steadily increasing number of published articles each year in education from 2015 to 2019 reflects how VR has become "popular" in education. In 2019 alone, 207 articles with "Virtual Reality" in their titles were published in journals that belong to the field of education.

Table 1 Number of publications in different fields from Web of Science (2015–2019)

Search terms	*2015*	*2016*	*2017*	*2018*	*2019*	*Total*
Title = "virtual reality"; "doc type= article"	1480	2170	3280	4280	5410	16620
*"Virtual Reality" + "field = Information science"	10	10	20	29	32	101
*"Virtual Reality" + "field = Computer Science"	24	25	30	40	22	141
*"Virtual Reality" + "field = design"	19	28	41	59	68	215
*"Virtual Reality" + "field = medicine"	42	53	54	80	122	351
*"Virtual Reality" + "field = education"	79	103	110	159	207	658
*"Virtual Reality" + "field = Engineering"	90	136	182	220	229	857
*Title = "virtual reality"; "doc type= article"						

The following Tables 2–4 reveal the information of the top ten journals (2017–2019) that publish the most articles with "Virtual Reality" in their article titles. We hope it is helpful for their future authors.

Table 2 Top ten journals that published articles with virtual reality in their titles in 2017

Rank	*Journal title (no. of articles)*	*Online journal information*
1	*Proceedings of SPIE* (17)	https://spie.org/publications/conference-proceedings
2	*Agro FOOD Industry Hi-Tech* (11)	https://www.journalguide.com/journals/agrofood-industry-hi-tech
2	*Frontiers in Psychology* (11)	https://www.frontiersin.org/journals/psychology
2	*Scientific Reports* (11)	https://www.nature.com/srep/about
3	*Journal of Digital Contents Society* (9)	http://journal.dcs.or.kr/
4	*Cyberpsychology, Behavior, and Social Networking* (8)	https://www.liebertpub.com/loi/cyber
4	*IEEE Transactions on Visualization & Computer Graphics* (8)	https://dblp.org/db/journals/tvcg/index
5	*Annual Review of CyberTherapy and Telemedicine (ARCTT)* (7)	http://www.arctt.info/
5	*Computers in Human Behavior* (7)	https://www.journals.elsevier.com/computers-in-human-behavior
6	*Plos One (6)*	https://journals.plos.org/plosone/

Table 3 Top ten journals that published articles with virtual reality in their titles in 2018

Rank	*Journal title (no. of articles)*	*Online journal information*
1	*Plos One* (28)	https://journals.plos.org/plosone/
2	*Frontiers in Psychology* (19)	https://www.frontiersin.org/journals/psychology
3	*Cyberpsychology, Behavior, and Social Networking* (13)	https://www.liebertpub.com/loi/cyber
4	*Neural Computing and Applications* (10)	https://www.springer.com/journal/521
4	*Proceedings of SPIE* (10)	https://spie.org/publications/conference-proceedings

Table 3 Top ten journals that published articles with virtual reality in their titles in 2018 (cont.)

Rank	*Journal title (no. of articles)*	*Online journal information*
5	*Annual Review of CyberTherapy and Telemedicine (ARCTT)* (9)	http://www.arctt.info/
5	*IEEE Access* (9)	https://ieeeaccess.ieee.org/
6	*IEEE Transactions on Visualization & Computer Graphics* (8)	https://dblp.org/db/journals/tvcg/index

*Only 8 journals were listed because next five journals all have published 7 articles.

Table 4 Top ten journals that published articles with virtual reality in their titles in 2019

Rank	*Journal title (no. of articles)*	*Online journal information*
1	*Virtual Reality* (20)	https://www.springer.com/journal/10055
2	*Frontiers in Psychology* (19)	https://www.frontiersin.org/journals/psychology
3	*Plos One* (17)	https://journals.plos.org/plosone/
4	*IEEE Access* (16)	https://ieeeaccess.ieee.org/
5	*Cyberpsychology, Behavior, and Social Networking* (15)	https://www.liebertpub.com/loi/cyber
5	*Proceedings of SPIE* (15)	https://spie.org/publications/conference-proceedings
6	*Applied Sciences Basel* (12)	https://www.journalguide.com/journals/applied-sciences-basel-
7	*IEEE Transactions on Visualization & Computer Graphics* (12)	https://dblp.org/db/journals/tvcg/index
7	*Journal of Anxiety Disorders* (12)	https://www.journals.elsevier.com/journal-of-anxiety-disorders
8	*Journal of Business Research* (11)	https://www.journals.elsevier.com/journal-of-business-research

We are living in a dynamic world with continuous changes. The information listed above related to VR will be different with this forthcoming special issue because of the valuable contributions our authors have made in the field, with new understanding of VR to support learning.

In the first article, Jackson and Park offered a lens into the use of virtual reality for healthcare education by presenting a model that showcases the potential application of creating and using virtual patients (VPs) for student training in pharmacy education. The authors suggest that the shared findings and lessons can be incorporated into the development of virtual simulations. The authors recommend that future research test the effectiveness of the VPs by measuring set outcomes such as communication skills or consultation knowledge/skill gains in the pharmacy classrooms with diverse student groups.

Stork, Fessenden and Zhang explored K-12 students' use of augmented reality (AR) to engage in literacy activities and examined teachers' perceptions of using augmented reality to help them support student engagement in literacy learning. The case study indicated the use of AR tools promotes student engagement in literacy activities, teachers are eager to further explore the potential of AR tools to support engagement in literacy, AR tools have the capacity to bring literacy to life in a 21st century learning

environment, and teachers need additional support to integrate AR tools for literacy instruction. In addition, the majority of students (78%) felt that the AR apps could help them become better readers. For emerging literacy tools such as augmented reality, recognising their limitations and affordances with K-12 literacy skills has significant implications for the students, teachers and researchers.

Zhang and Aslan provided a broad picture of virtual reality (VR) in undergraduate engineering education by examining research published from 2014 to 2020, critically reviewing the state of VR research, and highlighting its applications and educational benefits. The authors propose a new comprehensive framework, named *VR for industry-ready engineers*. This framework highlights four essential types of learning opportunities that are critical in engineering education. It also summarises the proven and promising VR applications to realise such opportunities and experiences

Lee and Yoon described the impact of augmented reality (AR) on mobile learning with children. The authors analysed children's perceptions of environmental sustainability with and without the use of AR. Results of the experimental case study demonstrate that AR was more engaging than books alone and more efficient at improving attitudes towards the environment. The authors recommend the adoption of AR to encourage empathetic and interactive interactions with environmental issues.

Wang, Magagna, Peck, Pfeifer and Wang collaborated to explore the perceptions of early adopters of augmented reality (AR) and virtual reality (VR) and its impacts on teaching and learning through semi-structured interviews. Results of the study revealed early adopters perceive VR and AR are making positive impacts on teaching and learning through improved learning interactivity and engagement, enhanced learner motivation, increased proficiency with targeted learning outcomes, and better transfer of learning to the intended work environments. The authors offer these results to support the proposition that emerging technologies such as VR and AR have long-term potential to enhance teaching and learning and to transform traditional learning environments.

Emihovich, Xu and Arrington collaborated to explore theories and strategies associated with immersive learning environments often created with VR. Their paper presents a conceptual framework that includes **S**ituated Learning, **P**lay, **E**mbodied Interactive Learning, **C**onnectivism and Social Learning, and **I**mmersive **A**ssessments for **L**earning (SPECIAL). This SPECIAL framework offers detailed accounts of each element synthesised from literature review, their reflections and discussions with peers and experts in the field, which provides a theoretical foundation for future research studies and instructional design practice with virtual technologies and immersive environments. Another significance in their efforts is the call for scientific explorations of VR for learning, professional training, and classroom instruction with sound theoretical supports.

Johnston and Collum explored the use of the simulation-based learning platform, simSchool, on pre-service teachers' understanding of diversity, and the educational needs of students with exceptionalities at ten universities in the USA and Puerto Rico. The analysis of the data from their study indicated that the use of the simSchool platform increased pre-service understanding of diversity and increased pre-service teachers' understanding of the educational needs of students with exceptionalities, differentiated instruction, and classroom management. The authors suggest that effective simulated environments can help pre-service teachers develop a methodology of teaching, enabling them to learn how to differentiate instruction, practice classroom management, and reflect on their practice.

Kim and Curry shared a scaffolded learning project for pre-service teachers to develop and integrate augmented reality (AR) technology into their classroom instruction. The paper took a reflective approach to share instructor experiences of working with those pre-service teachers. The paper offered detailed descriptions of the project, synthesised lessons learned, and shared their suggestions on how to work with pre-service teachers to integrate AR technology for instruction. The authors felt that building confidence and creativity through experiencing AR, creating a safe and stress-free learning environment, building a "Toolbox" for future classroom use, and creating a community of practice in the class are essential factors contributing to the success of the project.

Each article in this special issue offers a unique and significant perspective in exploration of VR and VR related issues. They reflect the authors' scholarly endeavours as well as their accomplishments which are informative and inspirational to other educational researchers. As editors, we are very grateful for that. The publication of this special issue is the hard work of many people. We are very grateful for the full support received from our reviewers whose names are too many to be mentioned here. Among them are our colleagues, Drs. Jingshun Zhang, Doug Carothers, Michael Houdyshell, Hasan Aydin, and Vickie Johnston at Florida Gulf Coast University. As guest editors, we especially appreciate Dr. Xiaoqing Gu, Editor-in-Chief of *International Journal of Smart Technology and Learning*, for her leadership, professional guidance, and shared vision as we worked on this special issue. In addition, we want to express our sincere gratitude to the technical supporters who worked so hard behind the scenes for the publication of this special issue. Finally, we are truly honoured and blessed to work as guest editors of this special issue. We want to say that our work ends here but our explorations of VR continue. So we would like to end this prologue with a quote from the Virtual Reality Society website: "We can expect to see many more innovative uses for the technology in the future and perhaps a fundamental way in which we communicate and work thanks to the possibilities of virtual reality" (2017).

References

Aqlan, F., Elliott, L.J. and Zhao, R. (2020) 'Measuring problem-solving skills with virtual reality', *Industrial Engineer*, Vol. 52, No. 2.

Becker, K. (2010) *The Clark-Kozma Debate in the 21-st Century*.

Dawley, L. and Dede, C. (2014) 'Situated learning in virtual worlds and immersive simulations', *Handbook of Research on Educational Communications and Technology*, Springer, New York, NY, pp.723–734.

Hwang, W.Y. and Hu, S.S. (2013) 'Analysis of peer learning behaviors using multiple representations in virtual reality and their impacts on geometry problem solving', *Computers & Education*, Vol. 62, pp.308–319.

Kim, B.R., Chun, M.H., Kim, L.S. and Park, J.Y. (2011) 'Effect of virtual reality on cognition in stroke patients', *Annals of Rehabilitation Medicine*, Vol. 35, No. 4, p.450.

Piaget, J. (1971) *Psychology and Epistemology: Towards a Theory of Knowledge* (A. Rosin, Trans.), Viking, New York.

Scoresby, J. and Shelton, B.E. (2011) 'Visual perspectives within educational computer games: effects on presence and flow within virtual immersive learning environments', *Instructional Science*, Vol. 39, No. 3, pp.227–254.

Shi, Y., Du, J. and Worthy, D.A. (2020) 'The impact of engineering information formats on learning and execution of construction operations: a virtual reality pipe maintenance experiment', *Automation in Construction*, Vol. 119, 103367.

Steuer, J. (1992) 'Defining virtual reality: dimensions determining telepresence', *Journal of Communication*, Vol. 42, No. 4, pp.73–93.

Tichon, J. and Burgess-Limerick, R. (2011) 'A review of virtual reality as a medium for safety related training in mining', *Journal of Health & Safety Research & Practice*, Vol. 3, No. 1, pp.33–40.

Virtual Reality (n.d.) *Introduction*. Available online at: https://vrsi.wordpress.com/ (accessed on 1 August 2020).

Virtual Reality Society (2017) *What is Virtual Reality*. Available online at: https://www.vrs.org.uk/virtual-reality/what-is-virtual-reality.html (accessed on 1 August 2020).

Wang, C., Song, H., Xia, F. and Yan, Q. (2009) 'Integrating Second Life into an EFL program: students' perspectives', *Journal of Educational Technology Development and Exchange*, Vol. 2, No. 1, pp.1–16.