Journal of Education for Business

ISSN: 0883-2323 (Print) 1940-3356 (Online) Journal homepage: https://www.tandfonline.com/loi/vjeb20

An application of virtual reality in education: Can this technology enhance the quality of students' learning experience?

Enda McGovern, Gerardo Moreira & Cuauhtemoc Luna-Nevarez

To cite this article: Enda McGovern, Gerardo Moreira & Cuauhtemoc Luna-Nevarez (2020) An application of virtual reality in education: Can this technology enhance the quality of students' learning experience?, Journal of Education for Business, 95:7, 490-496, DOI: 10.1080/08832323.2019.1703096

To link to this article: https://doi.org/10.1080/08832323.2019.1703096

JOURNAL OF EDUCATION FOR BUSINESS
2020, VOL. 95, NO. 7, 490–496
https://doi.org/10.1080/08832323.2019.1703096

Routledge
Taylor & Francis Group

INNOVATIVE INSTRUCTIONAL CLASSROOM PROJECTS/BEST PRACTICES

An application of virtual reality in education: Can this technology enhance the quality of students' learning experience?

Enda McGovern[a], Gerardo Moreira[a], and Cuauhtemoc Luna-Nevarez[b]

[a]Department of Marketing, Welch College of Business and Technology, Sacred Heart University, Fairfield, CT, USA; [b]Department of Management and Marketing, College of Business, Texas A&M University-San Antonio, San Antonio, TX, USA

ABSTRACT
Virtual reality (VR) technology is making its mark across market sectors (e.g., gaming, healthcare, tourism). This paper examines the use of VR in education, specifically in business classes, to better understand how this technology can help students improve their communication skills associated in delivering effective presentations and participating in public speaking events. The VR application allowed students to assess their presentation skills, to then practice in upgrading their skills, and gain more confidence in delivering effective presentations. Overall, this research demonstrates that the adoption of VR can be extremely beneficial to business educators in helping students enhance their presentation skills.

KEYWORDS
Business education; communication skills; digital pedagogy; virtual reality

Introduction

In recent years, the use of digital technologies in education has grown significantly at all academic levels, from elementary schools to post-graduate institutions. This has opened more opportunities for educators to embrace these technologies and improve the learning experience for incoming students who are born digital natives. While the adoption of digital technologies can help students increase their learning motivation and enhance their skills, educators face the challenge of identifying, evaluating and selecting the best technologies to achieve these goals. It is critical for educators to stay relevant on topics related to their discipline in order to find the appropriate technologies that can enhance their students' learning experience.

An important learning goal in most disciplines is to improve students' communication skills through class presentations. Presentations assess students' ability to prepare and display knowledge, while improving upon their communication skills. A presentation can be defined as a practiced speech that is delivered by a presenter, yet it is not memorized or read (Levin & Topping, 2006). In a classroom setting, students are not often aware of how well or poorly they may be performing in their presentations until after they receive a grade. While some professors may be committed to providing feedback (Wardrope & Bayless, 1994), others may opt to not provide direct feedback on students' presentation performance as students could perceive it as a personal criticism. According to Coffelt, Baker, and Corey (2016), developing presentation skills is highly valued by many institutions, such as the National Association of College of Employers (NACE) and the Association to Advance Collegiate Schools of Business (AACSB). These organizations have positioned effective oral communication as one of the top three most sought-after qualities when hiring individuals (NACE, 2018). Although the importance of presentations in education has been extensively studied, the context in which this research examines presentations is innovative because of the use of virtual reality (VR) technology. The VR application, called Ovation VR, provides students with a unique practice environment, an immersive "virtual" learning experience, and "unbiased" detailed feedback. Moreover, the Ovation software allows students to get real-time feedback during and after their practice sessions.

Given the relevance of understanding the value and impact of new technologies in business education, this paper examines the adoption of VR in business classes through an application that allows students to practice their presentation skills. Additionally, this paper analyzes the effectiveness of VR in enhancing the learning

CONTACT Enda McGovern mcgoverne@sacredheart.edu Department of Marketing, Welch College of Business and Technology, Sacred Heart University, 5151 Park Ave, Fairfield, CT 06825, USA.
Color versions of one or more of the figures in the article can be found online at www.tandfonline.com/vjeb.
This article has been republished with minor changes. These changes do not impact the academic content of the article.

experience of business students and discusses further implications of this technology in business education.

Background

The business world has dramatically changed over the past two decades. Most of these changes are directly associated with the adoption of the Internet and related applications and devices, such as smartphones, tablets, and computers. These technologies are continually evolving and becoming more influential in our daily lives. Artificial Intelligence (AI), the Internet of Things (IoT), Robotics, Augmented Reality (AR) and Virtual Reality (VR) are currently dominating the latest advances in the technology domain. As more businesses adapt to these emergent technologies, some sectors have lagged in the knowledge of being able to protect, or deflect, their existing operational models from this technological disruption. One sector that has struggled to engage this digital disruption to its full potential is the education sector, and more specifically, higher education. The cause of this resistance can be broken down into two key challenges. The first challenge is structural in form and refers to the inability of universities to fund the digital investment necessary to build new hardware and software technologies, while potentially needing to mothball existing resources. The second challenge refers to professors' inability or lack of appeal to adapt and engage the latest technologies in meeting the emerging demands of students.

A technology that is slowly entering the education sector is virtual reality (VR). VR can be defined as "a medium composed of interactive computer simulations that sense the participant's position and actions and replace or augment the feedback to one or more senses, giving the feeling of being mentally immersed or present in the simulation (a virtual world)" (Sherman & Craig, 2002, p. 16). The interest in VR has been trending up and down for the past 20 years. This is primarily because VR applications rely heavily on the latest advances in technology, necessary to facilitate the use of VR. The recent Internet developments with the creation of a 5 G network have become critical in developing the network to operate VR at exponentially increased speeds and traffic capacity (Newman, 2018).

Over the last decade, the adoption of VR has been examined in applications related to tourism (Bogicevic, Seo, Kandampully, Liu, & Rudd, 2019; Eckhaus, 2017; Tussyadiah, Jung, & Tom Dieck, 2018), medicine (Levac et al., 2016), gaming (Isar, 2018), firefighting (Williams-bell, Kapralos, Hogue, Murphy, & Weckman, 2015), the legal profession (Young, 2014) and construction management (Ahmed, 2019), among others. Tussyadiah et al. (2018) provided strong evidence in support of the effectiveness of VR in shaping tourists' attitudes and behaviors in a positive direction, leading to a higher level of visitor intention. In a more recent study, Bogicevic et al. (2019) evaluated the benefits of viewing three different hotel previews to deliver integrated tourist experience prior to booking of the actual hotel. Their results demonstrated that a VR preview "induces higher elaboration of mental imagery about the experience and a stronger sense of presence preview, thereby translating into enhanced brand experience" (p. 55).

Although VR has been proven valuable in tourism, medicine and other areas, research regarding the implementation of VR in educational settings is somewhat scarce. Procedures, including intubation and laparoscopy (fiber-optic instrument is inserted through the abdominal wall) along with eye surgery are areas showing strong development of using VR training techniques (Ruthenbeck & Reynolds, 2015). VR has been also utilized in preparing nursing students with basic nursing skills (Smith & Hamilton, 2015). Furthermore, the impact of VR applications has been evaluated on students' performance in the engineering discipline with positive results recorded among a group of 48 students (Alhalabi, 2016). The option of VR being used as a content delivery platform for class material has been explored in a business class. Students rated their enjoyment and interest to be higher, increasing their engagement in learning activities (Seung Hwan et al., 2017). A more recent educational use of VR occurred in Wako, Japan, where citizens were able to explore a model of a supernova in the immersive three-dimensional format (Impey et al., 2018). As the adoption of VR continues to spread in the education sector, more research is needed to understand the actual value and impact of such technology in higher education, and more specifically, in business education.

Methodology

Participants and research materials

This study was undertaken at a private northeastern university during the regular semester session. Due to the research design, between 1 and 1.5 hours were required to run the VR software with each student. The sample consisted of 71 students in three different sections of Introduction to Marketing classes (20, 25 and 26 students, respectively), and included 39 male and 32 female participants, with 14 freshmen, 37 sophomores, 13 Juniors, and 7 Seniors. This sample size is consistent with previous studies that engaged VR technological applications (Albert, Patney, Luebke, & Kim, 2017; Smith & Hamilton, 2015). None of the students who participated in the study had ever experienced the use of Ovation VR software or other VR applications in an educational setting.

The Oculus Rift, which is one of the most popular VR tethered headsets, was selected for the study. Running the Ovation VR software on the Rift allowed participants to deliver their virtual presentations while facilitating researchers' data collection. Ovation is recognized as a VR market leader platform that helps users overcome their fear of making presentations or speaking at public events (www.ovationvr.com). It offers several virtual settings for users to practice in front of different audiences, including a classroom, courtroom, boardroom and banquet room. When practicing in a virtual setting, participants are allowed to adjust their environment. They may stand at a podium or move around in the virtual room, use a hand held microphone (in the form of a controller), and/or use a prompter positioned either in front or behind them. As Ovation can record each presentation, participants can share their progress with other Ovation users and request external feedback as part of their learning process. Overall, Ovation seemed to be a natural fit for this research as it is well known that employers seek business graduates with strong communication skills. Thus, it is important for business educators to explore new technologies that can help students build and improve such skills.

Procedure

The research procedure included the following steps:

Step 1

All participants were provided with an elevator-pitch in the form of an 8-slide presentation deck, entitled "*Why Should High School Students go to College? Top 5 Reasons.*" This was necessary to allow all participants to work from the same script and connect with a topic relevant to them.

Step 2

Before performing their virtual presentations, participants were required to visit the VR lab and familiarize themselves with the hardware and software. In the lab, students were provided with the Oculus Rift headset (already loaded with the Ovation software), and required to put on the headset and navigate into the virtual classroom. At this time, they were not allowed to practice and were not informed about the software features. This was important in order to establish a baseline for each student's current level of presentation skills. During this visit, students signed a consent waiver and completed a brief Qualtrics online survey. The survey included questions related to their current level of confidence in making presentations, their motivation, and the perceived difficulty in completing the upcoming task.

Step 3

When students became familiar with the VR technology, they were required to put on the Oculus Rift headset and enter the Ovation virtual classroom to prepare for their first presentation. Participants in the virtual setting used an in-world representation (i.e., an avatar) to give their presentations. Once participants felt comfortable in the virtual classroom setting, they started delivering their first presentation (P_1), which was recorded on the Ovation platform.

Step 4

When participants finished their presentation (P_1), the data collected by Ovation was presented to each participant individually using a screen display (see Figure 1). This was the first time that participants were informed about the three main categories of metrics recorded by Ovation, namely *Gaze*, *Voice* and *Gesture*. These categories and corresponding metrics are explained as follows:

Gaze

This category includes two metrics: *Attention Distribution* and *Audience Stare*. *Attention Distribution* measures the presenter's eye contact with the audience during the presentation, while *Audience Stare* measures whether the presenter focuses too long staring at one person or spot in the room, normally recorded if the stare remains fixed for more than 5 seconds.

Voice

This category includes two metrics: *Words per Minute* and *Filler Words*. *Words per Minute* measures the speaking speed of the presenter. Ovation adopts a speaking rate of between 120 and 180 words per minute (wpm), which is the optimum band range for the audience to be able to follow the narrative. *Filler Words* records the number of filler or hesitation

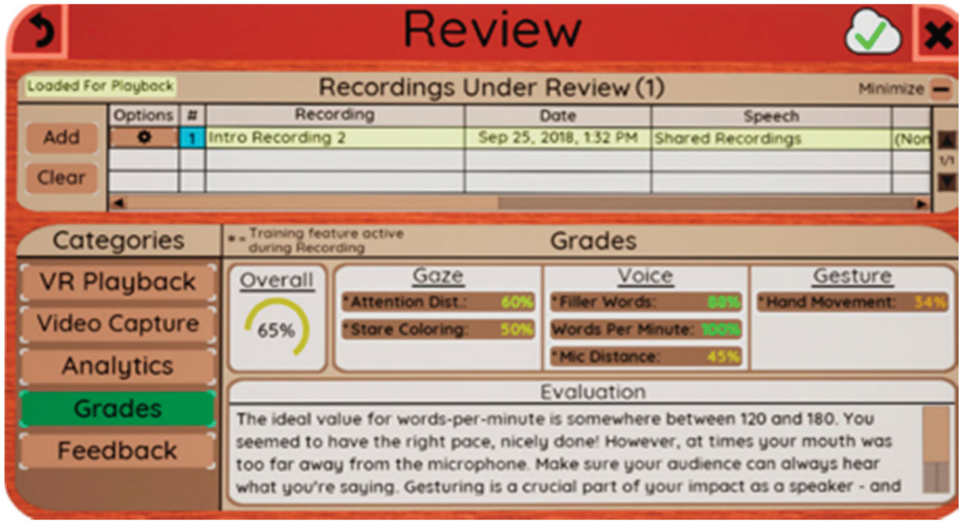

Figure 1. Screen display of recorded student data and feedback provided by Ovation.

words that a presenter uses in the spoken narrative. Words such as "*ah*," "*so*," "*but*," and "*just*" are considered examples of hesitation in Ovation. The higher the number of filler words, the greater the likelihood that the presenter is losing the audience's attention because their focus is being disrupted through constant hesitation.

Gesture

The only metric in this category is *Hand Gestures*. This is measured by the presenter's level of movement of the two Oculus Rift hand controllers, presented on a percentage scale.

Additionally, Ovation calculates a ***Total Score*** or grade for each presentation. This metric allows users to assess their overall performance during the presentation and use this score as a reference point for future practice sessions.

The results for all metrics were discussed with each participant in a 30-minutes session. Once this discussion was completed and all participants' questions were clarified, participants move to their second presentation (P_2).

Step 5

Participants performed their second presentation (P_2). All metrics were recorded, and the results were discussed with each participant and stored on Ovation for further analysis.

Step 6

Before leaving the VR lab, participants were required to complete a Qualtrics online survey, including questions related to their experience using the VR application and their improvement in presentation skills.

Data analysis, results and discussion

A paired samples t-test was used to compare participants' performance between presentations 1 (P_1) and 2 (P_2), and assess whether the mean scores from P_2 were statistically different than the mean scores from P_1, for the six metrics calculated by Ovation (attention distribution, audience stare, words per minute, filler words, hand gestures and total score). Table 1 shows a means comparison (P_1 vs. P_2) and other descriptive statistics for the six variables measures by Ovation. The results of the paired samples t-test (see Table 2) are explained as follows.

Attention distribution

Participants showed a better attention distribution during their second presentation, relative to their first one ($M_{P1} = 0.539$, $M_{P2} = 0.646$; $p < .01$). It seems that, during P_1, participants were not aware of the importance of looking at and visually engage the audience around the classroom. On many occasions, participants focused their attention on the slides, which limited their ability to interact with the audience. Conversely, during P_2, participants were actively scanning both sides of the classroom and adapted their presentation style to better engage the audience.

Audience stare

The results of the paired sample t-test demonstrate a significant improvement for participants' audience stare from presentation 1 to presentation 2 ($M_{P1} = 0.576$, $M_{P2} = 705$; $p < .05$). The instances of participants staring at one location during P_1 was evident. Some participants stated that they did not realize that they were doing this until the results were shared

Table 1. Means comparison for the six metrics calculated by Ovation (P_1 vs. P_2; $n = 71$).

	Mean	Standard deviation	Standard error mean
Attention distribution			
P_1	0.539	0.313	0.037
P_2	0.646	0.257	0.031
Audience stare			
P_1	0.576	0.437	0.052
P_2	0.705	0.424	0.050
Words per minute			
P_1	0.829	0.290	0.035
P_2	0.867	0.261	0.031
Filler words			
P_1	0.734	0.147	0.017
P_2	0.788	0.126	0.015
Hand gestures			
P_1	0.189	0.343	0.041
P_2	0.405	0.434	0.053
Total score			
P_1	0.579	0.173	0.021
P_2	0.685	0.168	0.020

with them (after completing P_1). Participants expressed how much they wanted to improve this skill for P_2, as there were many different details running through their mind in P_1, i.e., it was "involuntarily easy" to stare and not realize that it was occurring for the short period of time.

Words per minute

Results showed no statistically significant difference for words per minute (wpm) between presentations 1 and 2 ($M_{P1} = 0.829$, $M_{P2} = 0.867$; $p > .10$). This is not surprising because Ovation's acceptable range for this metric (between 120 and 180 words) is somewhat broad, thus most students stayed within this range during both presentations. However, it is important to note that there were some exceptions. For instance, one participant was extremely nervous and spoke above the 180 wpm mark for the majority of P_1. After discussing the results for P_1 with him, he continued to exceed the limit during P_2. After his second presentation, he commented that he knew he had to relax more and slow down but, once he started his presentation, he became so nervous that he just "wanted to get it finished."

Filler words

Participants used significantly less filler words during presentation 2 relative to presentation 1 ($M_{P1} = 0.734$, $M_{P2} = 0.788$; $p < .01$). During P_1, participants were using excessive filler words to either pause or stumble during the presentation. Feedback on this metric (after P_1) was surprising for many participants, as they did not realize that they were doing this. During P_2, students made a significant effort to not fall into this trap and focus more on delivering a clearer message. It is important to note that the filler words metric needs to be used carefully. In many presentations, people may use some filler words (e.g., "so") to help themselves deliver their message more effectively. Establishing a baseline on the use of these words should be considered in any analysis. Ovation software calculates the number of hesitation words, such as "um," "uh" and "etc." but does not require a baseline.

Hand gestures

Results demonstrate that participants improved their hand gestures from presentation 1 to presentation 2 ($M_{P1} = 0.189$, $M_{P2} = 0.405$; $p < .01$). Using hand gestures to help explain important points during a presentation can add value to the integrity of the presenter's message. It is evident that, during P_1, many participants were not aware of moving their hands to help them make a better presentation. Recording participants' movement of hands was very helpful, as many of them did not use hand gestures. After P_2, participants discussed how they wanted to focus more on this skill, as they now understand the importance of displaying more confidence and control by using hand gestures.

Total score

Overall, the total score of participants was significantly higher for presentation 2 relative to presentation 1 ($M_{P1} = 0.579$, $M_{P2} = 0.685$; $p < .01$). As explained before, the total score is calculated from the integration of three metric categories: gaze, voice and gestures. The total score was very valuable for participants because it helped them understand their overall performance in one single metric. Participants expressed that, with more practice sessions, they could work on improving their total score and increasing their confidence in preparation for actual live presentations in the classroom (i.e., facing the professor and classmates and not "virtual people").

Table 2. Results of a paired samples t-test (P_1 vs. P_2) for the six metrics calculated by Ovation ($n = 71$).

	t	df	Sig. (2-tailed) p-value
Attention distribution	−2.774	70	.007
Audience stare	−2.148	70	.035
Words per minute	−1.308	70	.195
Filler words	−5.049	70	.000
Hand gestures	−5.072	70	.000
Total score	−5.444	70	.000

Conclusions and recommendations for future research

This research demonstrates the potential of adopting VR technology to further enhance business education, in this instance, by enabling students to practice and improve their presentation skills. Our results provide significant evidence that VR can enhance students' ability to acquire a broader range of skills in nurturing their overall educational experience. The skillset required to become successful business professionals includes building strong presentation skills. Thus, business educators must invest some time in exploring and evaluating new technologies that can facilitate this task. Aside from these findings, the timing for the emergence of VR into the educational mainstream is now ripe for two primary reasons. The upcoming 5 G network will revolutionize the opportunity for many technologies to take the next dive into disrupting digital pedagogy across all educational levels. Simultaneously, the new generations of students are enthusiastic to embrace the latest technologies that can help them develop the skills demanded by an increasingly competitive job market.

Given that the adoption of VR in higher education is relatively new, we encourage other professors to seek out and collaborate with established VR companies developing educational software. Such companies can greatly benefit from a collaborative relationship with higher education institutions. The implementation of VR applications into the classroom can be initially challenging, as most students are not familiar with the hardware and software required by VR technology. As a result, professors need to plan carefully so that VR integration occurs as gradually and smoothly as possible. It is strongly recommended that such efforts engage the university's Information Technology (IT) office as their staff can assist faculty in maximizing both the utilization and engagement of the VR technology. For instance, the IT staff can help professors convert an office space or a small room into a functional VR space. In this study, researchers created a small lab environment in the library. While students were delivering their presentations behind a closed glass door, we considered it important for students to have privacy while presenting.

Lastly, while this paper explores the use of VR to develop students' presentation skills and provides positive evidence in support of the adoption of VR, future research might focus on evaluating students' performance when giving a presentation to a live audience after practicing with the VR software. This could further advance the potential benefits of adopting VR in business education.

References

Ahmed, S. (2019). A review on using opportunities of augmented reality and virtual reality in construction project management. *Organization, Technology and Management in Construction: An International Journal*, *11*(1), 1839–1852. doi:10.2478/otmcj-2018-0012

Albert, R., Patney, A., Luebke, D., & Kim, J. (2017). Latency requirements for foveated rendering in virtual reality. *ACM Transactions on Applied Perception*, *14*(4), Article 25. doi:10.1145/3127589

Alhalabi, W. (2016). Virtual reality systems enhance students' achievements in engineering education. *Behaviour & Information Technology*, *35*(11), 919–925. doi:10.1080/0144929X.2016.1212931

Bogicevic, V., Seo, S., Kandampully, J., Liu, S., & Rudd, N. (2019). Virtual reality presence as a preamble of tourism experience: The role of mental imagery. *Tourism Management*, *74*, 55–64. doi:10.1016/j.tourman.2019.02.009

Coffelt, T., Baker, M., & Corey, R. (2016). Business communication practices from employers' perspectives. *Business and Professional Communication Quarterly*, *79*(3), 300–316. doi:10.1177/2329490616644014

Eckhaus, E. (2017). Towards tourism business change. *Revista De Management Comparat International*, *18*(3), 274–286.

Impey, C., Wenger, M., Austin, C., Calahan, J., & Danehy, A. (2018). Videos for astronomy education and outreach. *Communicating Astronomy with the Public Journal*, *24*, 32.

Isar, C. (2018). A glance into virtual reality development using unity. *Informatica Economica*, *22*(3), 14–22. doi:10.12948/issn14531305/22.3.2018.02

Levac, D., Glegg, S. M. N., Sveistrup, H., Colquhoun, H., Miller, P. A., Finestone, H., & Velikonja, D. (2016). A knowledge translation intervention to enhance clinical application of a virtual reality system in stroke rehabilitation. *BMC Health Services Research*, *16*(1), 557.

Levin, P., & Topping, G. (2006). Perfect presentations. In L. Irvine (Ed.), *Orals ain't orals: How instructions and assessment practices affect delivery choices with prepared student oral presentations.* Paper presented at the Australian and New Zealand Communication Association Conference, Brisbane. Berkshire, England: Open University Press.

NACE. (2018). Employers want to see these attributes on students' resumes, *Job Outlook Survey*. Retrieved from https://www.naceweb.org/talent-acquisition/candidate-selection/employers-want-to-see-these-attributes-on-students-resumes/.

Newman, D. (2018). 4 Reasons 5G Is Critical For Mass Adoption Of AR And VR. *Fortune Magazine*, Mar 27th, 2018. Retrieved from https://www.forbes.com/sites/danielnewman/2018/03/27/4-reasons-5g-is-critical-for-mass-adoption-of-ar-and-vr/#501f9ac01878.

Ruthenbeck, G. S., & Reynolds, K. J. (2015). Virtual reality for medical training: The state-of-the-art. *Journal of Simulation*, *9*(1), 16–26. doi:10.1057/jos.2014.14

Seung Hwan, L., Sergueeva, K., Catangui, M., & Kandaurova, M. (2017). Assessing google cardboard virtual reality as a content delivery system in business classrooms. *Journal of Education for Business*, *92*(4), 153–160. doi:10.1080/08832323.2017.1308308

Sherman, W. R., & Craig, A. B. (2002). *Understanding virtual reality: Interface, application, and design*. San Francisco, CA: Morgan Kaufmann Publishers.

Smith, P., & Hamilton, B. (2015). The effects of virtual reality simulation as a teaching strategy for skills preparation in nursing students. *Clinical Simulation in Nursing*, *11*(1), 52–58. doi:10.1016/j.ecns.2014.10.001

Tussyadiah, I. P., Jung, T. H., & Tom Dieck, M. C. (2018). Embodiment of wearable augmented reality technology in tourism experiences. *Journal of Travel Research*, *57*(5), 597–611. doi:10.1177/0047287517709090

Wardrope, W. J., & Bayless, M. L. (1994). Oral communication skills instruction in business schools. *Journal of Education for Business*, *69*(3), 132–140. doi:10.1080/08832323.1994.10117670

Williams-Bell, F., Kapralos, B., Hogue, A., Murphy, B. M., & Weckman, E. J. (2015). Using serious games and virtual simulation for training in the fire service: A review. *Fire Technology*, *51*(3), 553–584. doi:10.1007/s10694-014-0398-1

Young, C. O. (2014). Employing virtual reality technology at trial: New issues posed by rapid technological advances and their effects on jurors' search for "the truth". *Texas Law Review*, *93*(1), 257–274.