

Immersive Interactive Educational Experiences— Adopting Education 5.0, Industry 4.0 Learning Technologies for Malaysian Universities

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ABSTRACT

Immersive and interactive educational experiences (2I2E, for short) is the future of teaching and learning, combining the best of Education 5.0 and Industry 4.0 learning technologies to engage learners from the present generation whose style of learning is unique to the digital age. However, creating immersive and interactive educational experiences is a real challenge for educators, especially those without technological know-how and those who do not see the importance of investing in the creation of technology-based educational contents. In this research paper, we highlight our efforts in trying to create immersive and interactive educational experiences to teach job-related skills for Industry 4.0 future workers. Taking onboard the notion of gamification and putting game-based element in what we term as 'learning sims' (learning simulations), we can strongly argue that these types of immersive and interactive educational experiences are the future of teaching and learning at Malaysian universities. However, there are many obstacles to the wider implementation of immersive and interactive educational experiences at Malaysian universities, for instance limited time for content development, limited technical and programming knowledge, and particularly limited financial resources to procure development software and state-of-the-art hardware to test these 'educational experiences'. In addition, the definition of what counts as engaging is constantly shifting, to the point where all content developers must be ready to be at the cutting edge. That said, the demand to create more and more immersive and interactive experiences continues to grow not just within the field of education but also in other areas like medical science and high technology manufacturing. Whatever it is, we believe that new learning technologies and educational experiences are not merely fads, they are glimpses of tomorrow's world, based on critical comments given by end users (university students) of a keystone project that we are working on called 'ELSA 360°-Videos'.

Key Words: Immersive learning, Interactive learning, Educational experiences, Education 5.0, Industry 4.0.

1. INTRODUCTION

During the last 50 years of human history, technology has made remarkable progress and growth, especially with the introduction of the Internet. With Industrial Revolution 4.0 currently upon us, having breakthrough technologies that allow us to fast-forward the speed of communication as well as facilitating information exchanges and business dealings within the space of a second, is nothing short of amazing (Ahmad, Adnan, Yusof, Mohd Kamal & Mustafa Kamal, 2019). Together with advancements in human societies, it can be said that the evolution of technology has been both directly and indirectly influential in changing and developing teaching pedagogies (see Adnan, Ahmad, Yusof, Mohd Kamal & Mustafa Kamal, 2019; Hamiti & Reka, 2012).

The setting of classrooms for the period of time before the year 1990 was more suited for the face-to-face method due to education being more teacher-oriented. Afterwards, as more technological means were becoming available together with the increased accessibility to them, classrooms of the combination of face-to-face and e-learning variants were becoming more common. Currently, fully e-learning applied teaching methods are frequently observed, as well as the emergence of flipped classrooms where the pedagogy is mainly focused on being student-oriented. For researchers and

practitioners in the field of education, the drive and enterprise in studying and exploring ways to exploit 21st century technologies to improve and enhance the teaching and learning dyad is imperative (Adnan & Zamari, 2012a, 2012b).

However, with rapid advancements in technology, unemployment is fast becoming a reality and an impending worry as more and more jobs are getting replaced due to the disruptive nature of technologies (Adnan, 2018). Summers (2014) indicates that the main problem stemming from the introduction of technologies is the causing of not enough work to go around. With the prevalence of robotics, artificial intelligence, 3D printing and other innovations, many workers in different economic sectors are losing jobs faster than society can create them. The idea of robots taking over the occupation of man is no longer an allegory to technological advancement in science fiction, but rather a sobering truth. The policymakers at the top of the education field have to understand and adapt to this situation, as Frey and Osborne (2015) maintain that only through a shift in the direction of comprehensive development can the occupational stagnation in economic sectors in the digital age be avoided. They assert that, "While the concern over technological unemployment has so far proven to be exaggerated, the reason why human labour has prevailed relates to its ability to acquire new skills" (p.89).

2. LITERATURE REVIEW

We are at the initial stages of the Fourth Industrial Revolution, which is bringing together digital, physical and biological systems (Schwab, 2016; Schwab & Davis, 2018). We are evolving into a new living system that would allow us to meet the basic needs of every human on the planet. The prediction of five million traditional jobs lost by the year 2020 to technology is serious. Industries like construction, manufacturing, health, education and services will continue to exist but because of the presence of the Fourth Industrial Revolution as a game changer, better education and better training should be provided to the young generation.

2.1. From traditional classrooms to virtual learning environments

The education system needs to step up its game to meet these new needs, and teaching methodologies in schools and colleges should no longer rely on traditional methods to impart knowledge (Mohd Kamal, Adnan, Mustafa Kamal, Ahmad & Yusof, 2019). Virtual Reality (VR) and Augmented Reality (AR) for student learning and development must revolutionise the way teachers teach, and students learn. We have seen a lot of changes in the education industry over the years. Nevertheless, there are still some old tools being used, such as PowerPoint. With the help of VR and AR, hopefully students will be able to learn interactively like never before (Adnan, Ahmad, Yusof, Mohd Kamal & Mustafa Kamal, 2019).

Virtual Reality (VR) technology allows users to be immersed in a virtual environment by directly interacting with its content. Although it is not a new concept, the development of new devices such as Head Mounted Displays (HMD) that embed two cameras enabling stereo vision and can be directly attached to mobile devices, have turned VR technology into a widespread consumer technology, providing innovative ways for immersion and interaction (VeeR, 2019). Virtual reality is also quickly changing the world of education. VR has been used in education starting from the first grade to college in the United States. Using VR headsets, students can see the immersive content of any subjects. Moreover, a 360-degree view of any content gives a more realistic feel to the students as they find themselves being part of the environment. That said, no matter how great a certain technology is, unfortunately there are some flaws detected on the features of VR. For example, the size and weight of VR goggles are quite bulky, making it difficult for users to use them. Moreover, some people will experience dizziness and motion sickness in VR.

At the same time, one of many advantages in using virtual reality technology for learning is how students are able to be involved in the virtual world and at the same time improving their concentration. VR provides students with a complete sensory experience through which they can virtually touch, see and hear contents (Choi, Dailey-Hebert & Estes, 2016). For example, the application 'King Tut VR', which is available on the Apple App Store and Google Play Android platform, provides the full experience of immersion into olden history. This app guides viewers into the tomb of the Pharaoh 'Tutankhamun' with a 360-degree virtual environment full of historical artefacts. With this technology, a student of history does not have to travel to Egypt to learn and experience this ancient history.

Not much different from Virtual Reality (VR), Augmented Reality (AR) uses the environment around it, then overlays animation or any form of information on it (Choi, Dailey-Hebert & Estes, 2016).

One of the biggest benefits of Augmented Reality application development is it does not need any dedicated device for displaying. Due to this, the technology will become mainstream in the very near future. Augmented Reality helps students, rather than merely reading a book chapter, to visualize the subject matter. It is true that not all subjects have that kind of advantage but in a way, it helps students gain better understanding and insights about certain academic subjects and topics. As aforementioned, one of the most significant benefits of Augmented Reality in learning and development is that it does not require any heavy investments regarding hardware. Students can experience Augmented Reality using their smartphones or tablets. An Augmented Reality application just needs a smartphone camera in front of a textbook to view a 2D image turning into a 3D animation. Dino Park AR for instance, available on the Apple App Store, provides an augmented reality experience by transporting students into the prehistoric era and they will be able to see dinosaurs moving around the classroom. Undoubtedly, Augmented Reality keeps younger students excited and interested in learning.

2.2. From virtual learning environments to interactive learning experiences

In the 4th Industrial Revolution, the digital economy will commercialise the technology of artificial intelligence, which as can be seen today, accompanies us in our daily work and entertainment. The technology has grown rapidly these past few years that gadgets for VR are now available at more affordable prices. With this, more people especially students, will have the chance to learn through a new method and not in the same traditional way. Other than using virtually-based technology for education, people are widely using it for entertainment. It is not something new but the widespread involvement of people in collaborative gaming adventures, gives advantages to everyone involved. For instance, gamers usually will connect with others from all over the world. Through interactions while gaming, this can give positive impact on one's communication skills and networking. Indeed, these advanced technologies have been utilized widely in the entertainment industry.

There are many other ways, for example in education, that Virtual Reality and Augmented Reality technologies can be put to good use. As Burton and Scott (2003) observe, museum attendance dropped 15.6% in Scotland, 12% in Australia, 9% in Germany, and 7% in Denmark over the past few decades. In contrast, socialising on the World Wide Web, learning through digital media, and engaging in computer-related activities such as video gaming are all on the increase. The enthusiasm about digital technologies could open new horizons to the world and industry of museums and exhibitions. For museums, as Burton and Scott (2003) argue, "If museums are to increase attendance, they need to position themselves as attractions with many of the attributes associated with the 'ideal' leisure activity" (p. 66). With this kind of reinvention, the number of visitors visiting museums will increase from time to time.

Current advances of Virtual Reality and Augmented Reality technologies have made it possible for people to experience another version of reality using digital machines. This provides better opportunities for architects and museum designers to utilise the idea of 'hybrid spaces'. Hybrid space can be defined as the tangible world of reality mixed with the intangible world of 'virtuality' in a single environment (Silva, 2006). Several researchers explore the concept of hybrid space within the context of VR and AR (see for example Manovich, 2006; Silva, 2006).

In 'Ultimate Dinosaurs: Giants from Gondwana' the Royal Ontario Museum in 2012 explored the mass use of AR technology. The exhibit integrated actual and virtual spaces in an immersive, interactive, and game-like environment. A visitor could look at a virtual dinosaur in its original size roaring dreadfully by simply pointing an iPad or iPhone. It was impossible to see virtual dinosaurs at a glance and visitors had to move around to have a complete understanding of these enormous creatures. The experience also included virtually fleshing out a dinosaur skeleton (Elshafie, 2015). Indeed, VR and AR provide the chance for the public to experience being in a historical event or to experience walking about in buildings from another era, in an immersive and interactive fashion. Thus, these technologies can be used "not only for the sake of preserving the cultural heritage, but also to make the information content accessible to the wider public in a manner that is attractive" (Styliani, Fotis, Kostas & Petros, 2009, p. 520).

2.3. 'Immersive Interactive Educational Experiences' and knowledge dissemination

The preceding sub-sections mention the advantages of Virtual Reality (VR) technology and Augmented Reality (AR) technology. If the education system implements these technologies in learning, students will highly likely gain so much than what they received now. Higher education

programs move increasingly to an online format because the sources now are more accessible, with wider range of contents as many more college and university students start using these technologies in learning. Therefore, educators need to be one step ahead in learning how to adapt technology in classroom pedagogy from traditional methods to more technology-friendly learning experiences.

Educational institutions have felt the need to enhance learning experience to make online courses more engaging and to provide more immersive learning experiences (Karaman & Ozen, 2016). Virtual worlds with computer-based simulations of objects and activities that appear in real life are the 'in' thing (Hartley et al., 2015). With this knowledge, educators can customize virtual classrooms to have content-specific information and resources continuously available in the virtual environment (O'Connor & Domingo, 2016). The ability to create environments has made virtual worlds useful for experiencing dangerous science labs and medical experiments or logistically impractical simulations, which online students would have great difficulty seeing and experiencing in person (Koglbauer, 2015; Urso & Fisher, 2015). A number of educational institutions around the world have taken steps to incorporate virtual environments into their online courses.

Without a doubt, there will be challenges that educators and students will experience. For example, students might not have sufficiently capable computer hardware and reliable Internet services or for some students, they will struggle to adapt to the new learning environment because they tend to have less experience with technology and somewhat fearful of new applications. However, through these gaps, the learning and teaching process gets better for both educators and students. The role of technology in education is constantly evolving. Technology creates 'learning opportunities' for students to explore academic disciplines through authentic methodologies and removes information barriers that often limit the content and experiences students encounter. Now, students can simply access most of the world's knowledge via the World Wide Web. As Brown (2015) noted, "What started out as something that was simply 'cool' has become a way to engage learners like never before".

As for VR, this technology allows students to explore full 360-degrees and three-dimensional (3-D) worlds (López, 2016). Students are now able to experience environments in which they are not physically present. Only gamers used to wear special video headsets to view virtual worlds in 3-D, Google later introduced an inexpensive cardboard viewer through which users could use mobile devices such as smartphones to view videos in 3-D. The same goes with 360-degrees videos, which enables students to observe a scene in whatever direction they wish. Students are able to virtually explore the world recorded using a 360-degrees video camera. On mobile devices, as students move and turn these devices left and right or up and down, the image they see moves in synchronization. On laptops and desktops, students can navigate spherical 360-degree videos by clicking and dragging on them. YouTube for instance is filled with 360-degrees videos. Not merely accessing these videos, students can upload and share their own video clips on a variety of popular platforms such as Facebook and YouTube.

There is also AR that can create Immersive Interactive Educational Experiences by extending the real-time environment with a digital overlay. The layer of virtual scene appearing on the actual real-life scene that students experience can make learning meaningful (Taskiran, 2018). Educators are beginning to embrace this technology and investigate further learning opportunities. This technology enables students to explore great museums of the world, bring dangerous or extinct animals to life where they can walk around and examine them, and also conduct hazardous science experiments without fear of being harmed. The social, affective and cognitive aspects of AR can lead to the creation of a productive learning environment that will increase student success, eventually (Yilmaz & Batdi, 2016).

3. RESEARCH METHODS

Based on the research literature above, qualitative data were collected from a series of 20 focus group discussions lasting about 1 hour for each session within a period of 10 weeks, involving 102 degree level students at a Malaysian public university campus (who were further divided into smaller discussion groups for the purpose of this study). Focus group discussion was used as the sole data collection instrument as it allows for the collection of ideas and opinions from a large participant pool whilst also opening up two-way channels for openly discussing a given topic (see Adnan, 2013a, 2013b, 2017). Employing an award-winning VR learning innovation project for English for Work-based and Professional Interactions that we are currently working on called '*ELSA 360°-Videos*' to stimulate the discussion sessions, we wanted to explore two central research questions below that are linked to the notion of Immersive Interactive Educational Experiences.

1st research question:

What are the advantages and disadvantages of learning using VR technology, based on what you have experienced through the ELSA 360°-Videos project?

2nd research question:

How would you improve the experience of learning using VR technology, if this technology is applied to the teaching and learning of your core academic subjects?

To facilitate the process of data collection and analysis, a number of students were also trained as ad-hoc secretaries to record the proceedings using their smartphones and to write up summaries of each focus group discussion session. This helped to increase the involvement of all the research participants as we only observed the proceedings without interrupting the flow. The qualitative data collected were, as norm, subjected to analytical coding and thematising. Salient points from the data are presented in the next section. Where names are used with quotations, these are actually pseudonyms chosen by the research participants involved in this study.

4. DATA PRESENTATION

This section presents answers to the two central questions that drive this research effort. First, *what are the advantages and disadvantages of learning using VR technology, based on what you have experienced through the ELSA 360°-Videos project?* And second, *how would you improve the experience of learning using VR technology, if this technology is applied to the teaching and learning of your core academic subjects?*

4.1. Advantages and disadvantages of learning using VR technology

Based on the comments shared by the majority of the participants in this study, the advantages of VR technology far outweigh its disadvantages, for the purpose of teaching and learning. The ELSA 360°-Videos project embedded 360° or spherical video clips within 'learning experiences' on the VeeR (2019) virtual reality video platforms. Using the concept of discussions that go on within corporate meeting rooms, users (i.e., the degree level students) go through a series of short discussions on various topics to teach them about workplace based and professional interactions.

Representing her discussion group, according to Miss 'Aliya', "The main advantage for us is we're able to feel like we're in the real situation, like in a real meeting with the actors and actress. We can learn sentences and also able to see the reaction of everyone [in the video]." In truth, all of the discussion groups made this observation and they also appreciate that VR technology helps them "to see" how to use correct together body language and how "to use" good facial expressions when they communicate professionally with other people. For Mister 'Haziq' and his group members, "We like that we can understand new skills, for example interpersonal skills and diplomacy skills, and all the professional skills that we need. It is like we ourselves are there in the meeting with you." Other advantages of VR in the teaching and learning this academic and professional subject are as below:

1. Improving English language skills easily by watching and listening, for example new vocabulary and getting new fresh ideas, also learn how to solve problems quickly on the fly and thinking outside of the box.
2. Can clearly see two-way communication and visually experience the learning on office issues because according to my friends this is a good example of how learning with new technology can make it nice to learn.
3. We are able to get clearer understanding and attain the new skills more quickly than just reading in the boring textbook, together with gaining confidence and becoming more talkative after we look and listen to how the professional people/workers actually talk in professional situations when they have important meeting agendas.
4. For us, we can be able to see all eye contact between all the interlocutors and people who are acting in the videos, getting to know about manners and how to interrupt during discussions from looking at the whole situation, 360 degrees in the meeting room. Then, we also see the correct way to use body gestures and face expressions, so we know how to talk effectively.
5. Getting the experience of the real situation as in the video, due to the 360-degrees camera full. And the main advantage of this is we are able to see and understand the real situation or discussion without going into a real meeting.
6. My friends said that we can improve our language and also see around the room, to see clearly what happened in the room and to understand what the speakers should do. So, when we do

our actual test we also can know how the real negotiation style takes place and how the discussion in the meeting should be done in professional situations like in the office and for office situations like when we negotiate with other people.

Disadvantages that they cite are as follows. Sometimes they could not catch on the real intentions of the video, so they need to watch the video more than one time due to the fact that these are 360-degree videos. They also argue that they need a lot of mobile data because they have to watch the video again and again, and sometimes the facial expressions are not that clear if they watch in lower resolutions. Poor Internet connection on campus grounds is also costly for them because they have to deal with not having enough mobile Internet data. Even though they like the technology, mobile data cost (as most of them use prepaid telephone lines) and constant buffering for some mobile carriers is so annoying to them even though they believe that in the future the technology will get better with 5G lines.

4. Should VR technology be applied to the teaching and learning of other subjects?

For this issue, it is a mixed bag because some of the students feel that they would want to try VR technology for their more difficult core subjects but for others, they feel that using this technology is not appropriate especially for subjects where they need to do calculations and computer programming or workshop-based experiments. However, for students who deal with studio-based drawings and technical drawings, and those who work with 3D models and physical models that represent actual physical things, these students feel that these subjects can really benefit from the use of Virtual Reality and even Augmented Reality technologies.

All in all, for the majority of students in the discussion groups, they are open to the idea of using Virtual Reality in the teaching and learning process at degree level. The only real barrier to them to accept this technology is the problem with expensive mobile Internet cost and the difficulty in getting stable Internet connections so that they can truly learn anytime and anywhere on campus, and from the comfort of their hostel accommodations. With this in mind, hopefully in the future more of their core subject lecturers would get on board and try developing VR or even AR contents to teach core subjects and technical subjects that give more weightage and are considered 'must pass' subjects for all of these degree level students.

5. CONCLUSION

Creating immersive and interactive educational experiences is a real challenge for educators, but we also need to consider how well end users (i.e., our own students) can accept and readily use learning technologies like Virtual Reality and Augmented Reality. Indeed, Immersive Interactive Educational Experiences (2I2E) are the future of teaching and learning at Malaysian universities. However, there are obstacles to be met that hinder the wider implementation of these educational experiences at Malaysian universities, for instance inadequate technical infrastructure and the burden of cost both on the content developers (the lecturers) and the end users (the university students). That said, the demand to create more and more immersive and interactive experiences continues to grow not just within the field of education but also in other areas. Whatever it is, we truly believe that new learning technologies and educational experiences that subscribe to the notion of 'Immersive Interactive Educational Experiences' are not merely fads, they are glimpses of the world of tomorrow, based on the comments shared by the degree level students who have tried using our 'ELSA 360°-Videos' project.

REFERENCES

- Adnan, A. H. M. (2013a). Language use and identity construction in a 'micro-community' of Malay undergraduates. In R. Machart, C. B. Lim, S. N. Lim, & E. Yamato (eds.), *Intersecting Identities and Interculturality: Discourse and Practice* (pp. 91-110). Newcastle upon Tyne: Cambridge Scholars Publishing.
- Adnan, A. H. M. (2013b). *Language use and workplace participation in the identity construction of Bumiputera Malay undergraduates in Malaysia* (unpublished Doctor of Philosophy thesis). University of Auckland, New Zealand.
- Adnan, A. H. M. (2017). Learning English (and Arabic) in Malaysian Islamic Schools: Language use and the construction of identities. *Arab World English Journal*, 8(2), 407-420.
- Adnan, A. H. M. (2018). Industry 4.0 skill sets, higher-order thinking skills and gamification: Lessons from 'Potentia Project', Malaysia (Plenary Panel Presentation). Proceedings from TING X 2018: *The Tenth National Meeting*

- of Teachers (*Temu Ilmiah Nasional Guru*) 'Innovation in Education for Indonesia 4.0'. Tangerang: Universitas Terbuka Indonesia.
- Adnan, A. H. M., & Zamari, Z. M. (2012a). "I am a Techno-Rebel!" Malaysian Academics & their Personal Experiences of Progressing into e-Learning. *Procedia-Social and Behavioral Sciences*, 67, 61-72.
- Adnan, A. H. M., & Zamari, Z. M. (2012b). Computer-Aided Self-Access Language Learning: Views of Indonesian, Malaysian & New Zealand Practitioners. *Procedia-Social and Behavioral Sciences*, 67, 49-60.
- Adnan, A. H. M., Ahmad, M. K., Yusof, A. A., Mohd Kamal, M. A., & Mustafa Kamal, N. N. (2019). English Language Simulations Augmented with 360-degrees spherical videos (ELSA 360°-Videos): 'Virtual Reality' real life learning! In MNNF Publisher / InIIC Series 1/2019 (eds.), *Leading Towards Creativity & Innovation*. Senawang: MNNF Publisher.
- Ahmad, M. K., Adnan, A. H. M., Yusof, A. A., Mohd Kamal, M. A., & Mustafa Kamal, N. N. (2019). Using new technologies to teach English in Malaysia - issues and challenges. Paper presented at the *International Invention, Innovative & Creative Conference (InIIC Series 1/2019)*, Malacca, Malaysia.
- Burton, C., & Scott, C. (2003). Museums: Challenges for the 21st century. *International Journal of Arts Management*, 5(2), 56-68.
- Choi, D. H., Dailey-Hebert, A., & Estes, J. S, (eds.) (2016). *Emerging Tools and Applications of Virtual Reality in Education*. Hershey, PA: Information Science Reference.
- Elshafie, S. J. (2015). Ultimate dinosaurs: Giants of Gondwana—Royal Ontario Museum traveling exhibit. *Journal of Vertebrate Paleontology*, 35(4), e943401.
- Frey, C. B., & Osborne, M. (2015). Technology at work: The future of innovation and employment. Retrieved from https://www.oxfordmartin.ox.ac.uk/downloads/reports/Citi_GPS_Technology_Work.pdf
- Hamiti, M., & Reka, B. (2012). Teaching with Technology. *Procedia - Social and Behavioral Sciences*, 1171-1176.
- Hartley, M. M., Ludlow, B. L., & Duff, M. C. (2015). Second life: A 3D virtual immersive environment for teacher preparation courses in a distance education program. *Rural Special Education Quarterly*, 34(3), 21–25.
- Karaman, M. K., & Ozen, S. (2016). A survey of students' experiences on collaborative virtual learning activities based on five-stage model. *Journal of Educational Technology & Society*, 19(3), 247–259.
- Koglbauer, I. (2015). Training for Prediction and Management of Complex and Dynamic Flight Situations. *Procedia - Social And Behavioral Sciences*, 209 (The 3rd International Conference "Education, Reflection, Development", 3rd–4th July 2015, 268–276.
- López, L. L. (2016). Virtual reality and augmented reality in education. Retrieved from <https://elearningindustry.com/virtual-reality-augmentedreality-education>
- Manovich, L. (2006). The poetics of augmented space. *Visual Communication*, 5, 219-240.
- Mohd Kamal, M. A., Adnan, A. H. M., Mustafa Kamal, N. N., Ahmad, M. K., & Yusof, A. A. (2019). 60 seconds 'Video-based Learning' to facilitate Flipped Classrooms and Blended Learning at a Malaysian university. Paper presented at the *International Invention, Innovative & Creative Conference (InIIC Series 1/2019)*, Malacca, Malaysia.
- O'Connor, E. A., & Domingo, J. (2017). A practical guide, with theoretical underpinnings, for creating effective virtual reality learning environments. *Journal of Educational Technology Systems*, 45(3), 343–364.
- Schwab, K. (2016). *The Fourth Industrial Revolution*. Geneva: World Economic Forum.
- Schwab, K., & Davis, N. (2018). *Shaping the Fourth Industrial Revolution*. Geneva: World Economic Forum.
- Silva, A. S. (2006). From cyber to hybrid: Mobile technologies as interfaces of hybrid spaces. *Space and Culture*, 9, 261-278.
- Styliani, S., Fotis, L., Kostas, K., & Petros, P. (2009). Virtual museums, a survey and some issues for consideration. *Journal of Cultural Heritage*, 10, 520-528.
- Summers, L. H. (2014). Lawrence H. Summers on the economic challenge of the future: Jobs. Retrieved from <http://www.wsj.com/articles/lawrence-h-summers-on-the-economic-challenge-of-the-future-jobs-1404762501>
- Taskiran, A. (2018). The effect of augmented reality games on English as foreign language motivation. *E-Learning and Digital Media*, 16(2), 122-135.
- VeeR (2019). *Introducing VeeR Experience: Create interactive VR experience in minutes*. Retrieved from <https://veer.tv/landing/experience>
- Yılmaz, Z. A., & Batdı, V. (2016). A meta-analytic and thematic comparative analysis of the integration of augmented reality applications into education. *Eğitim ve Bilim*, 41(188), 273–289.