9th International Conference on Mass Customization and Personalization – Community of Europe (MCP - CE 2020)
Re-innovating Business in the Digital Era
September 23-25, 2020, Novi Sad, Serbia

THE IMPACT OF VIRTUAL AND AUGMENTED REALITY ON MASS CUSTOMIZATION AND PERSONALIZATION

Jelena Ćurčić, Anja Jakšić, Ksenija Mitrović, Danijela Gračanin, Jelena Spajić
University of Novi Sad, Faculty of Technical Sciences, Novi Sad, Republic of Serbia

Abstract: *In order to improve business and increase efficiency, organizations strive for innovative solutions that are offered by the time we live in. The development of technology has led to the development of virtual and augmented reality that have changed industrial processes and other spheres of consumption. Virtual Reality (VR) is now recognized as a technology that contributes to a personalization in the shopping experience and is used by many organizations to adapt their business to new trends. Augmented Reality (AR) is a technology that blurs the lines of reality and changes the image of a user's view of the real world. The purpose of this paper is to highlight the connection of VR and AR technologies with industrial processes as well as their impact on mass customization and personalization of products, in order to create unique value for the customer. Through secondary data analysis, this research highlights some of the industries and best cases which use VR and AR tools in their business processes in order to apply mass customization and personalization approach.*

Key Words: ***Mass Customization and Personalization, Virtual Reality, Augmented Reality***

1. INTRODUCTION

In order to achieve competitive advantage, brands today should allow their customers to personalize their products [1]. As customers' digital addiction transcends the screen, companies are adopting *Virtual Reality* (VR) and *Augmented Reality* (AR) and introducing the world of immersion to their customers. Today, brands strive to engage customers on multiple platforms, and they create successful interaction through VR and AR. These technologies are recognized as an innovative solution that contributes to a personalization in the shopping experience. In addition to the ability to accelerate online shopping [2], the power to attract consumers to the point of sale to meet the virtual experience is also being recognized [3].

Tracking a user's movement through a virtual environment provides an insight into their behavior patterns and shows their preferences [4]. VR and AR will probably transform the shopping experience, moving it out of the classic environment. The product can be visualized, but also tested. Trying the product before buying it, with the possibility of changing something in the form, color or size personalizes the purchase experience.

Enabling 3D virtual objects to supplement the real world are occurring through different applications and devices. Many industries realized how to use the power of digital information and experiences that are augmented and shared in order to achieve a higher level of personalization. Digital technologies offer an opportunity for new production processes - the ones that focus on individual needs and preferences and create personalized products [5]. Prosperous acceptance and implementation of VR and AR technologies in online retailing indicate a demand of "more efficient and enhanced consumer-friendly shopping interfaces" [6]. The aim of this paper is to highlight the importance of usage of VR and AR technologies in the context of Mass Customization and Personalization (MCP). Through a method of secondary data review, a subject of analysis are successful case studies that indicates the benefits of VR/AR usage in MCP processes.

Inspired by the research done for one of the previous MCP conference that explained the phenomenon of VR shopping [3], we will exhibit the contribution of using VR and AR technology in business and its impact on creating unique value for the customer.

2. VIRTUAL REALITY

Because of the great possibility to exhibit believable experience, VR tools engross huge attention [7]. Burdea and Coiffet [8] describe VR technology as an interactive real-time simulation used to create an immersive reality with a realistic feel. It is defined as a set of technologies used to synthesize an authentic set of visual, auditory, tactile and other sensory experiences in order to create an interactive interface between its user and virtual worlds [9]. Within computer-generated simulation of an alternative environment, people are being fully immersed

into it, with no contact with their physical world. Participants can be placed in scenarios that depict potentially real events, with the probability that they will behave and react realistically.

VR technology requires appropriate equipment so it can achieve adequate isolation from the physical surroundings. Heim [10] identifies seven convergent concepts of VR:

1. Simulation;
2. Interaction;
3. Artificiality;
4. Immersion;
5. Telepresence;
6. Full Body Immersion;
7. Networked Communications.

He also emphasizes the importance of immersion, which separates the user from the distractions of the real environment and draws him into the virtual world to create a complete experience. In order to provide the impression of human presence in the virtual world, the support of devices for communication between people and computers is needed. In addition, modern computer networks are used in order to achieve this communication with regard to the separation of the user and the distant environment [10].

In the virtual world, customer can make modifications that are consistent, since the interface is intuitive and they could experience the outcome of their adjustment in real-time [6]. Virtual environment engages customers and has the ability to influence their purchasing decision [11]. It enables them to explore products from different angles, perspectives and distances, giving them insight into product features and functions [12]. VR tools facilitate information stream about products to online buyers and sellers at retail stores [7].

3. AUGMENTED REALITY

AR is defined as a direct or indirect representation of the physical environment in the real world that is enhanced by adding virtual elements to it [13]. Covering the physical world with digital information is a key feature of this technology. AR allows users to see the real world at the same time as virtual images. It places people in the environment that is enriched with simulated objects. Customers can access AR on their own mobile devices, such as smartphones, tablets and laptops [14]. That ease of use and experiential value are recognized as the power of this persuasive technology that influence customer behavior in virtual environments [15].

The use of this technology leads to many advantages. Innovative and efficient solutions are now presented and used for improving the production processes. In order to achieve better product and process development, production systems could be supported by AR technology. That leads to shorter time, reduced cost and improved quality [16]. By delivering digital information around the world, this technology makes it easier for complex business systems to function better. It was developed as an idea of potentially advanced technology that would enhance and facilitate human interactions with objects and the environment.

The use of AR is in expansion because AR provides appealing and practical experiences, which enable users to participate at events or through generated virtual augmentation accomplish complex tasks [17]. Chavan [18] implies several characteristics of AR technology that provides benefits of its usage:

- AR increases user's knowledge and level of information;
- People can share experiences with each other in real time over long distances;
- Games generated within AR provide an even more "real" experience to the user.

According to Poushneh [17], there are three attributes that contribute to the quality of augmentation: *information quality*, *mapping quality and self-empowerment*. Information quality stands for the capability of creating personalized, credible and useful content. Mapping quality refers to the level of AR being able to map created virtual content such as pictures, objects, information onto the appropriate place. The third attribute relates to the right enrichment of the physical environment that matches the users' intent and stimulate their awareness of surroundings.

AR is characterized by simplicity, interactivity and an attractive approach. It offers an interactive experience by upgrading the real user environment [19]. AR layer has an influence on customer purchasing decision, giving them the ability to evaluate the product and interact with it [20]. AR systems change the way the user perceives and communicates with the real world.

4. THE BROAD USAGE OF VR AND AR

The retail landscape faces the challenges and modifications with information and communication technology rapidly advancing. Customers are now interested in technology-based innovations that help their shopping experience but also entertain them. They show an increasing expectation for more engagement [21]. As 3D graphics evolve, new solutions are presented and virtual experiences become vivid and more real. Papagiannidis et al. (2017) state that engagement is understood as a trigger for enjoyment and customer satisfaction [21].

The VR visualization and interaction with data is relevant for scientific evaluation and also in the fields of training and education. According to Hwang and Hu research [22], the use of a virtual environment has many advantages in education, e.g. in mathematics, when learning geometry it is much easier for students to master the material through VR. By using VR tools, in context of the virtual playground in education, students increase their activities, participate and work instead of observing [23]. Over the years, more areas are adopting AR and realizing its benefits. The first systems were focused on military, industrial and medical usage, but that range is now expanded to commercial use, entertainment [24], gaming, tourism, arts, etc. [25] AR technology found its use in education too. Its potential reflects in the promotion of interactive experiences both inside and

outside the classroom [26]. A different teacher-student interaction scenarios can be supported by the AR system, maximizing learning transfer [27].

VR is an irreplaceable tool in the development of "applications and simulations used in education, healthcare, the military and corporate training, integrating entertainment, haptic and other human-centered concepts and designs to intensify senses of realness and immersion in order to improve the effectiveness of achieving organizational goals" [28].

Immersive VR has great value for surgery training. Medical students have the possibility to learn anatomy using virtual technology which gives them 3D models of the human body. Also, VR is used in different medical treatments, for example, in treatments of mental health problems [23]. The great contribution of AR is recognized in the treatment of anxiety disorders, like phobias [29]. Within healthcare, AR applications give real-time information to support diagnosis, surgery and treatment plans [30].

5. THE USAGE OF VR AND AR IN MCP

Mass customization and personalization approach makes a company more flexible and responsive to the market needs, what makes company faster and effective in business. VR and AR are recognized as technologies with the potential to offer more differentiated and personalized experience [31].

The user experience can be explained as: “All the aspects of how people use an interactive product: the way it feels in their hands, how well they understand how it works, how they feel about it while they are using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it” [32]. The many features of a product, such a “usability, functions, size, weight, symbols, aesthetic, and usefulness” take influence in user experience [17].

Through communication with customers, the sales department of some organization can provide product which respond to all customers' needs. According Joseph Pine [33], mass customization presents "developing, producing, marketing and delivering affordable goods, and services with enough variety and customization that nearly everyone finds exactly what they want." Along with Tseng and Jiao, the target of mass customization is to produce goods and services conditioned to the individual needs of customers [34]. Mass customization makes customers active participants [35] in order to satisfy them. This concept integrates customers into value creation, so they can develop their own solution within pre-defined options [36]. In that manner, they are participants of co-design activities. Pine suggests that customers don’t want to have a choice, but an input in the design of their desired product [33]. Interactive marketing facilitates the implementation of customized marketing strategy [37].

Internet has provided new possibilities for personalization. Blom defines personalization as a process that “changes the functionality, interface, information content, or distinctiveness of a system to increase its personal relevance to an individual” [38]. Personalization is system oriented, while customization is user-initiated [38].

Interactive technologies are modifying the way products are being developed, promoted and sold. Customers’ satisfaction is higher when their needs are accurately fulfilled. Digital era requires personal marketing approaches. Communication with specific customer with support in using personal information is becoming more important. Barutcu, Yaldir and Hasiloglu highlight two reasons for personalization: the ability to attract customer attention and achieving marketing effectiveness [39]. People are attracted to the design elements that match their personality and taste [35], while messages that coincide with customer identity are more persuasive [40].

A variety of different forms of AR are developed and used in different concepts, depending on a company’s goals: mobile applications, head-mounted display, contact lenses and devices [17]. AR generates personalized output from user’s location, personal images and other personal data. In addition, AR usage in retail and promotional contexts has a huge spectrum of the advantages regarding to building realistic picture of products in customer awareness is obvious [41].

Customers are able to visualize and try on products, communicate with sellers and get thorough information on offerings. AR has the ability to facilitate real-time experience through virtual tryout and also, can provide relevant information that could be used for future to improve targeting [42]. AR enables users to visualize and try clothes, jewelry, make-up, etc. While using this technology, invisible avatar is automatically being customized, based on the user’s body size and skin color [43]. Fitting room is moved to user’s space and clothes are available for tryout without going to the store.

AR can be utilized also for getting customers into virtual tour where they can walk through the store while software would allow them to “see their store list virtually while they shop, see their coupons and prices tied to their loyalty membership on the shelf, have live directions to guide them to specific items in the store, and have a more personalized and interactive experience with the store location” [44].

Poushneh indicates that companies need to be careful when designing an experience with AR elements, because violating customers feeling of privacy destroys their satisfaction [17].

Digital tools give to customers’ ability to try clothing, shoes and glasses on themselves in virtual space [41]. A chance to virtually try on clothes accelerates the act of purchasing since the shopper can visualize the clothes without actually wearing it, but also narrow down the selection. VR makes simultaneous perspective and comparison of possible outfits [43]. Choosing from different customizable clickable elements on the brand’s website is now upgraded with the possibility of full immersion and interaction with the product. The right item can be chosen accurately, swapping options until the customer is fully satisfied. The contribution of VR is relevant for products that are highly customizable [7]. The benefits are even greater within companies that offer especially bulky items. For their retail stores are hard to exhibit a wide selection of those products in order to

meet customers' individual tastes. Oh, Yoon and Hawley [7] advocate several advantages that customization could have by implementing VR:

- Real-time 3D interactive views allow users to rotate, tilt and magnify product images to closely examine them from all angles;
- Users can communicate with each other in different location;
- User can visualize and manipulate an unlimited number of products;
- Perception of size, layout, and match with multiple items is accurate, etc.

Letting customers into virtual stores gives a brand the possibility to track and measuretheir behavior and comprehend patterns. With that insight and better understanding of customer preferences, brands could make their marketing strategies more personalized, which will enhance customer experience.

6. CASE STUDY ANALYSIS

In statistics published by Forbes [46], over 100 million customers will use VR and AR technology to shop online and in store by 2020. The predictions show that in USA, AR and VR market will be worth $215 million. In retail and marketing, VR is predicted to generate $1.2 billion in 2022. Greenlight VR's research showed that 53% of customers are more likely to purchase from brands that have VR experiences [47]. According to International Data Corp., digital reality markets (AR and VR) are projected to grow from $5.2 billion in 2016 to more than $162 billion in revenue by 2020. The AR market is estimated to grow by 85 percent per year for the next three years [48]. By 2021, AR market revenue will be worth $134 billion and according Digi-Capital's forecast for 2020, future AR revenue could total be $120 billion (Fig. 1) [48]. The VR market is set to grow at an accelerated rate over the next few years and may be worth $30 billion by 2020[48].

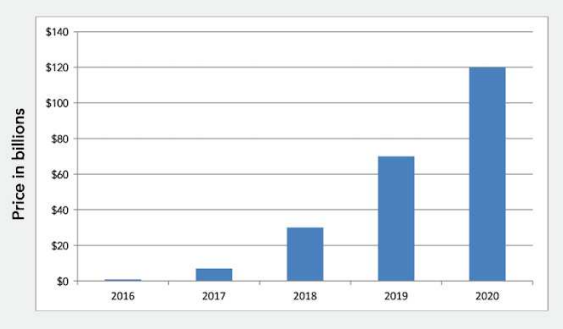

Figure 1 – Forecast for AR revenue by 2020 [45]

A study of more than 1,000 American customers showed that 61% of respondents prefer stores that offer AR, and 68% say they would spend more time at a retailer that offered AR [49].

The AR market is expected to be valued at 35 billion dollars by 2025, and the adoption rate of AR technology will be comparable to that of smartphones, according to Goldman Sachs [49]. Among the industries that are using AR, excluding video games, retail is expected to be the first market that uses AR frequently [50]. Companies such as "*Adidas, American Apparel, Anthropologie furniture, Lacoste shoes, L'Oréal, Lowe's, RIXO London,* and *Sephora* already offer AR technology on their mobile websites" [51].

Using the case study method as a qualitative research method, individual cases were analyzed in the context of VR and AR usage in MCP. This research approach presents an intensive, in-depth, detailed study or research of an individual case, where the focus is on specific subject of observation. As one of the key characteristics, the ability of accessing to various sources of data is emphasized. The main advantage of this method is that the experiential basis is being complemented with creating new sources of data [52]. Therefore, two cases of VR and AR application in *Ikea kitchen* and *Sephora* will be analyzed in following sections.

6.1. Ikea VR Kitchen Experience

Ikea designed the *IKEA VR Kitchen Experience app* that took users into the kitchen by allowing them to navigate through it, explore it, and perform some tasks as they do within their own, realistic kitchen [53]. By downloading the app from the Steam platform and running it with the help of HTC Vive, customers can explore the kitchens of this brand in a virtual environment. With a simple click, the color of the kitchen elements can be changed, they can be opened and viewed from different perspectives: with 100 cm, the user's height and 195 cm [53]. Thus, these options help users to come up with the best solution and assemble their desired kitchen, but also to have a fun experience in the virtual world.

Through this project, customers have been given a more significant role: they contribute to the creation and development of new products and combinations through the feedback they leave during their VR experience [54]. VR Kitchen Experience acts as a communication process between customers and the brand and connects them by reducing the gap between them [55]. VR has been used to give customers a better understanding of what to think about when planning and designing a kitchen. Inside this virtual space inspiration and co-creation of desired pieces and combinations are encouraged.

Following the reactions and comments of users, the team updated the application and added new features. On the Steam platform, where the application is available, a total of 294 people rated the application and as a result, the user's satisfaction is presented as mostly positive. 73% of people consider the application a positive VR experience [56].

Advocating the belief that they sell not only products, but also experience, *Ikea* invited customers to a new, immersive world in which customer interaction with the brand's offer and its values is ensured. Beside this virtual experience, *Ikea* also created AR application that enables users to visualize and manipulate 3D products within their personal space. The company's goal was to provide solutions that are most suitable for the individual needs of customers. In addition to that, they achieved advanced elimination of error regarding do purchase decision making.

6.2. Sephora Virtual Artist

As a leader in the cosmetic retail, *Sephora* gained reputation through its innovation and expertise. This company counts over 2600 stores in 34 countries all over the world. It offers their clients' possibility to see and test over 14.000 products from 200 different brands. In 2016, *Sephora* launched their AR tool - *Sephora Virtual Artist*. When Sephora realized that the technology was sufficiently precise and high quality, it realized that it could impact their business [57]. Sephora worked for five years to launch this online platform and since its launch in 2016, every four months they add more innovative features in the application. The AR features used in Virtual Artist are the following [58]:

1. Product Try-On; this function enables customers to virtually try on eye, lip and cheek makeup, in many different colors and palettes. They can then save their favorite combinations in "My Looks" and share them with friends.
2. Looks; customers may get inspired by specific looks created by experts and try them on themselves. The different groups are divided by category (daytime, trend, night time and natural).
3. Virtual tutorials; customers can learn new techniques by professionals step-by-step, straight on their faces.
4. Color Match; users can find the perfect makeup shades that match an outfit, an accessory or a celebrity look.
5. Swatch me; a virtual arm swatch is available to try and compare hundreds of shades instantly.

In the first eight weeks, the *Virtual Artist* tool was visited 1.6 million times, and customers tried on 45 million makeup products using the AR functionality [59].

According to the research [58], where *Sephora* website is compared with *Sephora Virtual Artist* (SVA), the results showed that SVA affects positively on the online purchase intention of customers. Customers are more interested to buy on SVA application instead of official website. The research was based on whether the perceived trust, perceived value, perceived risk barriers and attitude toward brand affect online purchase intention. Since launching, the SVA has seen 200 million shades tried on, over 8.5 million visits to the feature and most clients visit the app several times per month, to check everything from content to personalized messaging, according to the company.

7. CONCLUSION

In an era where customers require products that can help them to express their uniqueness, VR and AR technologies are implemented to allow them to achieve that in a more personal way. VR and AR are widely used in the retail industry to satisfy increasing customers' expectation to engagement [21]. The empirical part of this paper summarized various applications based on VR and AR that creates a personal virtual experience in order to attract users while focusing on their identity and taste. Presented VR and AR solutions provide additional details about products and allow customers to virtually visualize them. Also, these solutions encourage customer to purchase. According to the prominent statistics and secondary data analysis, it can be concluded that the expansion of AR and VR technologies is warranted in the future. This is an opportunity for companies to incorporate this type of technology into their business. In the cases of *Sephora* and *Ikea*, the engagement of customers has increased by the existence of applications in VR and AR technology. More than half of the users of the *Ikea application* have a positive experience and opinion, while an increasing number of customers decide to buy through *Sephora's Virtual Artist* in relation to shopping through the site. Both of brands regularly introduce new features and constantly improve the customer experience.

For the further researches it would be appreciable to follow the development of these applications and reveal the benefits of the improvements for specific companies. According to the limitation of this paper, which focuses only on the analysis of case studies, future research should examine in more depth the user perspective of the usage of these technologies, and their impact on creating the customized experience.

This paper contributes to the theoretical corpus of papers dealing with the research on application of new technologies in MCP. Through the analysis of practical examples presented in this paper is contributed better understanding and bring forward the importance of user experience management in term of successful trade.

Keeping up with new technology and integrating it into business activities is one of the biggest challenges for brands, but it brings a higher level of personalization, greater interactivity and the opportunity for event participants to become its creators, changing content, flow and even ambience in real time.

8. REFERENCES

[1] D. Mourtzis, M. Doukas, and D. Bernidaki, "Simulation in Manufacturing Review and Challenges", *Procedia CIRP*, vol. 25, pp. 213-229, 2014.

[2] Y. Lin, S. Yu, P. Zheng, L. Qiu, Y. Wang, and X. Xu, "VR-based product personalization process for smart products", *Procedia Manufacturing*, vol. 11, pp. 1568-1576, 2017.

[3] D. Dinu, D. B. Gajić, V. B Petrović. M. Lazor, and Z. Anišić, "State of the Art in Virtual Reality Shops", *8th International Conference on Mass Customization and Personalization – Community of Europe (MCP-CE 2018)*, pp. 74-80, 2018.

[4] E. Pantano, and R. Servidio, "Modeling innovative points of sales through virtual and immersive technologies", *Journal of Retailing and Consumer Services*, vol. 19, no. 3, pp. 279-286, 2012.

[5] M. Alcaniz, E. Bigne, and J. Guixerez, "Virtual Reality in Marketing: A Framework, Review and Research Agenda, *Frontiers in Psychology*, vol. 10, pp. 1530, 2019.

[6] F. Bonetti, G. Warnaby, and L. Quinn, "Augmented Reality and Virtual Reality in Physical and Online Retailing: A Review, Synthesis and Research Agenda", in T. Jung, and C. Tom Dieck,

"Augmented Reality and Virtual Reality: Empowering Human, Place and Business" pp. 119-132, Springer International Publishing, 2018

[7] H. Oh, S.-Y. Yoon, and J. Hawley, "What virtual reality can offer to the furniture industry", *Journal of Textile and Apparel, Technology and Management*, vol. 4, no. 1, June 2004.

[8] G. Burdea, and P. Coiffet, *Virtual Reality Technology*. Hoboken, NJ, USA: John Wiley and Sons, 2003.

[9] A. B. Craig, W. R. Sherman, and J. D. Will, *Developing Virtual Reality Applications: Foundations of Effective Design*. Elsevier Inc, 2009.

[10] M. Heim, *The metaphysics of Virtual Reality*. New York: Oxford University Press, 1993.

[11] Y. Lin, S. Yu, P. Zheng, L. Qiu, Y. Wang, and X. Xu, "VR-based product personalization process for smart products", *Procedia Manufacturing*, vol. 11, pp. 1568-1576, 2017.

[12] A. J. Fiore, "For fun and profit: hedonic value from image interactivity and responses toward an online store", *Psychology and Marketing*, vol. 22 no. 8, pp. 669-694, 2005.

[13] Z. Jiang, and I. Benbasat, "Virtual Product Experience: Effects of Visual and Functional Control of Products on Perceived Diagnosticity and Flow in Electronic Shopping", *Journal of Management Information Systems*, vol. 21, no. 3, pp. 111-147, 2004.

[14] J. Carmigniani, B. Furht, M. Anisetti, P. Ceravolo, E. Damiani, and M. Ivkovic, "Augmented Reality Technologies, Systems and Applications", *Multimedia Tools and Applications*, vol. 51, pp. 341–377, 2011.

[15] A. Rese, D. Baier, A. Geyer-Schulz, and S. Schreiber," How augmented reality apps are accepted by consumers: A comparative analysis using scales and opinions", *Technological Forecasting and Social Change*, vol. 124, pp. 306-319, 2017.

[16] H. Lee, A. Fiore, and J. Kim, "The role of the technology acceptance model in explaining effects of image interactivity technology on consumer responses", *International Journal of Retail & Distribution Management*, vol. 34, no. 8, pp. 621-644, 2006.

[17] A. Poushneh, "Augmented reality in retail: A trade-off between user's control of access to personal information and augmentation quality", *Journal of Retailing and Consumer Services*, vol. 41, pp. 169-176, 2018.

[18] S. R. Chavan, "Augmented Reality vs. Virtual reality: Differences and Similarities", *International Journal of Advanced Research in Computer Engineering & Technology*, vol. 5, no. 6, pp. 1947-1952, 2016.

[19] T. Olsson, E. Lagerstam, T. Kärkkäinen, and K. Väänänen, "Expected user experience of mobile augmented reality services: A user study in the context of shopping centres", *Personal and Ubiquitous Computing*, vol. 17, pp. 287-304, 2013.

[20] A. Watson, B. Alexander, and L. Salavati, "The impact of experiential augmented reality applications on fashion purchase intention"*International Journal of Retail & Distribution Management*, vol. 48, no. 5, 2018.

[21] S. Papagiannidis, E. Pantano, E. See-To, C. Dennis, and M. Bourlakis, "To immerse or not Experimenting with two virtual retail environments", *Information Technology and People*, vol. 30, no. 1, pp. 163-188, 2017.

[22] W.-Y. Hwang, and S.-S. Hu, "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, 2013.

[23] M. Slater, and M. V. Sanchez-Vives, "Enhancing Our Lives with Immersive Virtual Reality", *Frontiers in Robotics and AI*, vol. 3, 2016.

[24] D. Van Krevelen, and R. Poelman, "A Survey of Augmented Reality Technologies- Applications and Limitations", *The International Journal of Virtual Reality* vol, 9, no. 2, pp. 1-20, 2010.

[25] I. Ilhan, I., and E. Celtek, "Mobile Marketing: Usage of Augmented Reality in Tourism", *Gaziantep University Journal of Social Sciences*, vol. 15, no. 2, pp. 581-599, 2016.

[26] M. Da Silva, J. Teixeira, P. Cavalcante, and V. Teichrieb, "Perspectives on how to evaluate augmented reality technology tools for education: a systematic review", *Journal of the Brazilian Computer Society*, vol. 25, no. 3, 2019.

[27] C. Dede, "Immersive interfaces for engagement and learning". *Science*, vol. 323 pp. 66–69, 2019.

[28] M. Zyda, "From Visual Simulation to Virtual Reality to games", *Computer*, vol. 38, ,no. 9, pp. 25-32, 2005.

[29] P. Cipresso, I. Giglioli, M. Raya, and G. Riva, "The Past, Present, and Future of Virtual and Augmented Reality Research: A Network and Cluster Analysis of the Literature", *Frontiers in Psychology*, vol. 9, 2018.

[30] B. Marr, 9 Powerful Real-World Applications Off Augmented Reality (AR) Today, *Forbes*, (2018). https://www.forbes.com/sites/bernardmarr/2018/07/30/9-powerful-real-world-applications-of-augmented-reality-ar-today/#b1651732fe95 (accessed March 06, 2020).

[31] D. McKone, R. Haslehurst, and M. Steingoltz, "Virtual and Augmented Reality Will Re-Shape Retail", *Harvard Business Review*, 2016.

[32] L. Alben, "Defining the criteria for effective interaction design*", Interaction*, vol. 3, pp. 11-15, 1996.

[33] J. Pine, *Mass Customization: New Frontier in Bussiness Competition*. Boston, Massachusets: Harvard Business School Press, 1993.

[34] J. Jiao, and M. Tseng, "Understanding product family for mass customization by developing commonality indices" *Journal of Engineering Design*, vol. 11, no. 3, pp. 225–243, 2000.

[35] Y.-P. Luh, J.-B. Wang, J.-W. Chang, S.-Y. Chang, and C.-H. Chu,"Augmented reality-based design customization of footwear for children", *Journal of*

Intelligent Manufacturing, vol. 24, no. 5, pp. 905-917, 2013.
[36] F. Piller, K. Moeslein, and C. Stotko," Does Mass Customization Pay An Economic Approach to Evaluate Customer Integration", *Production Planning and Control*, vol. 15, no. 4, pp. 435-444, 2004.
[37] W.-S. Yoo, and Y.-J. Lee, "The role of interactivity in e-tailing: Creating value and increasing satisfaction" *Journal of Retailing and Consumer Services*, vol. 17, no. 2, pp. 89-96, 2010.
[38] J. Blom, "Personalization-a taxonomy" *Extended Abstracts of the CHI 2000 Conference on Human Factors in Computing Systems*, 2000. pp. 313-314
[39] S. Barutcu, A. Yaldir, and S.-B. Hasiloglu, "From Mass to Personalized Mobile Marketing Strategies: The New Dimensions Through Expert Systems"*European Scientific Journal*, pp. 400-409, 2017.
[40] S. C. Wheeler, R. E. Petty, and G. Y. Bizer,"Self-schema matching and attitude change: Situational and dispositional determinants of message elaboration", *Journal of Consumer Research*, vol. 31, no. 4, pp. 787–797, 2005.
[41] F. Turner, and I. Welch, "The Mixed Reality Toolkit as the Next Step in the Mass Customization Co-Design Experience", *International Journal of Industrial Engineering and Management*, vol. 10. no. 2, pp. 191-199, 2019.
[42] G. Hiranandani, K. Ayush, V. Chinnaobireddy, A. Sinha, P. Maneriker, and S. Maram, "Enhanced Personalized Targeting Using Augmented Reality" in *IEEE International Symposium on Mixed and Augmented Reality (ISMAR-Adjunct)*,2017, pp. 69-74
[43] M. Yuan, I.R. Khan, F. Farbiz, S. Yao, A. Niswar, and M. Foo,"A Mixed Reality Virtual Clothes Try-On System", *IEEE Transactions on Multimedia*, vol. 15, no. 8, pp. 1958-1968, 2013.
[44] M. Daiker, T. Ariyachandra, and M. Frolick, "The Influence of Augmented Reality on Retail Pricing", *Issues in Information Systems*, vol. 18, no. 4, 2019.
[45] B. Morgan, Top 80 Stats About A Future Customer Experience Shaped By Technology, *Forbes* (2019). https://www.forbes.com/sites/blakemorgan/2019/11/01/top-80-stats-about-a-future-customer-experience-shaped-by-technology/#2101465d35c2 (accessed February 06, 2020).
[46] J. Nafarrete, 53% of Consumers Likely to Purchase from Brands that Sponsor VR, *VRscout* (2016). https://vrscout.com/news/consumer-virtual-reality-survey/# (accessed February 06, 2020).
[47] M. Attaran, and R. Morfin-Manibo, "Your Future Reality will be Digital", *ISE Magazine*, pp. 26-31, 2018.
[48] J. Tramontana, Five Emerging Trends In Retail Technology, *Forbes* (2020). https://www.forbes.com/sites/forbesagencycouncil/2020/02/05/five-emerging-trends-in-retail-technology/#6cd95048ec4a (accessed June 02, 2020).
[49] The Goldman Sachs Group, Inc, Profiles in Innovation: Virtual and Augmented Reality - Understanding the Race for the next Computing Platform, *Goldman Sachs* (2016) https://www.goldmansachs.com/insights/pages/technology-driving-innovation-folder/virtual-and-augmented-reality/report.pdf (accessed February 06, 2020).
[50] A. Sheehan, How These Retailers Use Augmented Reality to Enhance the Customer Experience, *Shopify* (2018). https://www.shopify.com/retail/how-these-retailers-are-using-augmented-reality-to-enhance-the-customer-experience (accessed June 06, 2020).
[51] S. Ševkušić, "Kvalitativna studija slučaja u pedagoškim istraživanjima: saznajne mogućnosti i ograničenja", Zbornik Instituta za pedagoška istraživanja, vol. 40, no. 2, pp. 239-256, 2008.
[52] T. Åkesson, VIRTUAL REALITY - INTO THE MAGIC, *Ikea* (2016). https://www.ikea.com/ms/en_JP/this-is-ikea/ikea-highlights/Virtual-reality/index.html (accessed June 06, 2020).
[53] K. Mitrović, "Upotreba tehnologije virtuelne i proširene stvarnosti u marketingu", *Zbornik radova fakulteta tehničkih nauka*, vol. 35, no.2, 2020.
[54] D. Marini, R. Folgieri, D. Gadia, A. Rizzi, "Virtual reality as a communication process", *Virtual Reality*, vol. 16, no. 3, pp. 233-241, 2012.
[55] Ikea VR Experience - Steam. (n.d.). https://store.steampowered.com/app/447270/IKEA_VR_Experience/ (accessed June 06, 2020).
[56] A. D. Rayome, How Sephora is leveraging AR and AI to transform retail and help customers buy cosmetics, *Tech Republic* (2018). https://www.techrepublic.com/article/how-sephora-is-leveraging-ar-and-ai-to-transform-retail-and-help-customers-buy-cosmetics/ (accessed June 14, 2020).
[57] M. Santulli, "The influence of Augmented Reality on Consumers' Online Purchase Intention: The Sephora Virtual Artist Case" Dissertation, Universidade Católica Portuguesa, 2019.
[58] H. Milnes, Makeup brands are testing augmented reality to drive conversions, *DigiDay* (2016). https://digiday.com/marketing/makeup-brands-testing-augmented-reality-drive-conversions/ (accessed July 04, 2020).

CORRESPONDENCE

Jelena Ćurčić, Assistant-Master
University of Novi Sad
Faculty of Technical Sciences,
Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia
curcicj@uns.ac.rs

Anja Jakšić, PhD student
University of Novi Sad
Faculty of Technical Sciences,
Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia
jaksica@uns.ac.rs

Ksenija Mitrović, PhD student
University of Novi Sad
Faculty of Technical Sciences,
Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia
ksenijam@uns.ac.rs

Danijela Gračanin, Assoc. Prof.
University of Novi Sad
Faculty of Technical Sciences,
Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia
gracanin@uns.ac.rs

Jelena Spajić, Asst. Prof
University of Novi Sad
Faculty of Technical Sciences,
Trg Dositeja Obradovića 6
21000 Novi Sad, Serbia
stankovicj@uns.ac.rs