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Augmented reality: a new learning experience among health care professionals

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ABSTRACT

Background and Objective: Augmented reality (AR) is an effective tool for learning as well as marketing with multilateral interactive communication. It allows brands to give their customers unique experiences with the convenience of tapping into their mobile devices. This study was conducted to assess the perceptions of healthcare professionals (HCPs) to learn through AR and its effectiveness in HCPs' engagement and learning experience.

Methods: An interventional study was conducted with HCPs across various tertiary care hospitals in Pakistan from May 2020 till December 2020. An AR-based activity was carried out with the HCPs where they used pictures of objects around them to create a message. These were geo-tagged to a question related to hypertension and participants answered each question. Mobile application - WallaMe was utilized for this activity. At the end of the activity, HCPs were requested to fill a feedback form based on their experience with the AR app. Data were entered and analyzed by using SPSS version 22.

Results: AR stimulated learning gives the participants an overall exciting (80%), captivating (81%), and fruitful learning experience (82%). AR for marketing campaign was more effective for brand recall with paper-based campaign for 82.8% and more effective than digital campaign for 85.6% participants. AR was recommended by 80% participants for learning and brand recall.

Conclusion: AR is a useful tool to enhance user experience for learning as well as improves brand recall and can be used for marketing campaigns.

Keywords: Augmented reality, hypertension, medical education, brand recall, brand engagement.

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Introduction

Augmented reality (AR) is considered as an effective tool with multilateral interactive forms of communication and hence, allows active participation in the communication process. Interactivity can be seen as central factor enhancing depth of information processing on the part of the students as well as consumer.[1] This technology aims to augment the experience of real world environment by supplementing it with computer generated graphics and designs.[2] Along with AR, there is another environment of extended reality called virtual reality (VR). In both mediums, there are real as well we virtual environments generated by computer graphics and integrated for seamless interaction. Both environments serve to present the consumers with an enriched experience of the virtual world. However, there are differences in the purpose, immersion spectrum, technology, and delivery method between the two. AR mainly adds a virtual component including stickers, digital photos, and other graphics as an interactive layer between the real and the virtual world, VR creates its own reality which is entirely computer generated. VR activities require some form of gear - headset, controller, game consoles - to enter into the environment and is then controlled by the movement of the gear. For AR, mostly mobile applications are used in coordination with the mobile camera. AR-based mobile applications use image registration, computer vision, and Global Positioning System for graphics fit in and can perform more seamlessly with the real environment.[2]

AR technology allows virtual objects to coexist with the real world in real space. It has a great potential to enhance situational and contextual learning. It allows students to

interact with the virtual world and explore its complex interconnections with the real world. AR technology is being vastly utilized across various educational disciplines including chemistry, geography, history, environmental science, and healthcare. AR provides simulated experiences which enhance spatial concepts, help in acquiring skills, strengthening psychomotor abilities, shortening learning curve, and prolonging learning retention.[3] AR tools could guide students through the learning process in an enhanced way, as AR can upgrade traditional books with a digital layer. AR has improved both teaching and learning experience, and brought interactive dimension into the whole picture. This new technology has sped up the memorization process and increased the understanding of learning material.[4] AR is considered as a novel learning technique and has been employed in a wide array of healthcare related educational topics. There is a positive acceptance of AR among the health-care professionals as an effective learning tool and enhancing their capabilities.[3]

AR enables consumers to obtain (almost) real product experiences by the way of virtual information even before the purchase of a certain product. The aim of AR applications in relation with advertising is in-depth examination of product characteristics to enhance product knowledge as well as brand knowledge. Interactive design of advertising provides observers with an intense examination of a specific advertising message, and therefore leads to better brand knowledge.[5] AR benefits brands by providing a real-time experience to the consumers. The technology aims to advertise a brand in great depths which consequently results in stronger brand knowledge and recall. Brand knowledge describes the fact that consumers are able to build their own individual image of a brand based on recognition and recall.[5] Based on the work of Bluearca and Tamarjan (2010), five measures of perceived value of using AR have been chosen - enhancing convenience, influencing enjoyment, relevancy of idea, ease of interaction, and word of mouth.[6] Brands are intangible assets that enable firms to engage customers for greater economic stability.[7] AR enhances knowledge and awareness of the brand among the consumers which strengthen consumer loyalty toward the brands and enables the customers to make a more accurate choice toward purchasing.[8]

Education and learning today is majorly driven by the needs and desires of the learners. With the advancements in technology, these desires are constantly evolving. It has become essential for the health care professionals related to the field of teaching or marketing, to keep pace with these developments. Over time, since its introduction in education, AR has shown numerous advantages over traditional learning models. Some of these include utilization of a tangible interface metaphor for object manipulation providing a continuous interaction between the virtual and the real world. Such an emerging trend may provide the learners and consumers with unique experiences by a convenient tapping into their mobile devices. This helps the teachers and learners in utilization of a tangible interface metaphor for object manipulation providing a continuous interaction between the virtual and the real world. This study was, therefore, conducted to assess the perception of healthcare professionals (HCPs) to learn through AR and its effectiveness in HCP engagement.

Methods

An interventional study was conducted with HCPs across various tertiary care hospitals in Pakistan. The study duration was from May 2020 till December 2020.

Procedures and questionnaires for survey have been reviewed and approved by Inner city fund (ICF) Institutional Review Board of the Demographic and Health Surveys Program.

All participants were included after obtaining informed consent. Sample size was calculated using OpenEpi sample size calculator. After assuming 50% learning and engagement effectiveness of AR, at 8% margin of error and 95% confidence interval, at least 151 participants were recruited for this study.

For AR-based activity, mobile application - WallaMe was utilized.[9] WallaMe is a free iOS and Android app. It allows its users to hide and share messages in the real world using AR. Users can take a picture of any object around them and write, draw and add stickers and photos to it. Once the message (called Wall) is completed, it is then geolocalized and remains visible through WallaMe's AR viewer to everyone passing by. A Wall can also be made private, thus becoming visible only to specific people. For the purpose of this activity, all participants were requested to install "WallaMe" AR in their mobile phones. Facilitators conducted the group activity with 10 to 15 pre-defined objects programmed to the app. Each object was geo-tagged with one question related to guidelines of hypertension management. The question would appear through an AR app and participants were supposed to answer it on the given sheet in a specific time. Participants were then divided into groups and asked to perform AR digital learning activity. At the end of all the activities, the participants were requested to fill a feedback survey form based on their experience with the AR app.

Statistical analysis

Data were entered and analyzed by using SPSS version 22. Testing the AR in enhancing the learning experience and brand recall, correlation and multiple regression analyses were conducted. A *p*-value of <0.05 was taken as statistically significant.

Results

There were 160 participants in the study; females were more than males (56% *vs.* 44%). The attitude of the HCPs toward AR-based learning is summarized in Table 1. Among the participants, 82% strongly agreed that AR-based activity was a good learning experience and 84% strongly agreed that AR-based activity increased their curiosity to learn new things (Table 1).

Role of AR-based activity in brand recall is shown in Table 2. It shows that for 82%-86% HCPs, the AR-based activity on the app WallaMe regarding questions related to hypertension was more effective than paper based and usual digital campaigns. AR experience was recommended to others by 80% of enrolled HCPs (Table 2).

Using correlation analysis, the effect of AR in enhancing the learning experience is $R^2 = 0.221$ and in brand recall is $R^2 = 0.141$. As a result of the analysis of variance test, a significant effect on learning experience (0.041) while an insignificant effect on brand recall (0.096) was observed.

Discussion

This study evaluated the role of AR-based activities in enhancing learning and brand recall among HCPs. We found that AR technology stimulated learning curiosity giving

***Table 1.** Role of AR in enhancing the learning experience (N = 160).*

Variables	Frequency *N* (%)
Age (Mean ± SD)	26.68 ± 6.71
Gender	
Male	70 (43.75)
Female	90 (56.25)
This experience stimulated my curiosity to learn new things	
Strongly agree	134 (83.75)
Neutral	20 (12.5)
Strongly disagree	6 (3.75)
AR provided a good experience for learning	
Strongly agree	132 (82.5)
Neutral	21 (13.1)
Strongly disagree	7 (4.37)
AR experience was captivating	
Strongly agree	130 (81.25)
Neutral	25 (15.9)
Strongly disagree	2 (1.25)
AR experience was entertaining	
Strongly agree	141 (88.12)
Neutral	11 (7.1)
Strongly disagree	3 (1.87)
AR experience contributed positively to my overall experience	
Strongly agree	122 (76.25)
Neutral	24 (15.6)
Strongly disagree	8 (5.0)
Did this application impress you instantly?	
Strongly agree	120 (75.0)
Neutral	30 (19.1)
Strongly disagree	7 (4.37)
Did you find the application exciting?	
Strongly agree	128 (80.0)
Neutral	18 (11.8)
Strongly disagree	6 (3.75)

Table 2. Role of AR in enhancing brand knowledge and recall (N = 160).

Variables	Frequency N (%)
Do you think utilization of AR for marketing campaign compared to paper-based campaign is more effective for brand recall	
Strongly agree	131 (82.87)
Neutral	22 (14.0)
Strongly disagree	4 (1.62)
Do you think utilization of AR for marketing campaign compared to usual digital campaign is more effective for brand recall	
Strongly agree	137 (85.6)
Neutral	16 (10.1)
Strongly disagree	5 (3.12)
After AR experience, would you prefer to prescribe Telsarta A in your hypertensive patients	
Strongly agree	128 (80.0)
Neutral	26 (16.5)
Strongly disagree	4 (2.5)
Do you recommend others after experiencing AR	
Strongly agree	126 (80.2)
Neutral	25 (15.9)
Strongly disagree	6 (3.75)

participants an overall exciting, captivating, and fruitful learning experience. It was more effective than paper based and usual digital campaigns in terms of brand recall and knowledge.

In earlier studies, it has been reported that AR improves both teaching and learning experience as it is interactive and makes education interesting. Kraut et al.[4] reported that students learned faster and easily when AR applications were used. In conclusion, they found that AR was a promising tool and could help improve the learning among students. Another study by Kamphuis et al.[10] indicated that it is not possible to conduct real-life classes due to many possible causes. For instance, during COVID-19 pandemic, governments globally ordered lockdowns to mitigate the spread of the virus. All real-life classes were suspended and moved to online-classes for an indefinite time. In such situations, alternative methods are required to continue teaching. AR is an excellent alternative to traditional learning methods. It offers a highly realistic situated learning experience which supports the complexity of medical learning and transfer. The review claimed that AR uses virtual experience and offers a physical real world, hereby augmenting the perception of reality among users. AR technology motivates learners and tutors to refine their skillsets and enhance their efficacy.[5,10]

When virtual illustrations and annotations are augmented with physical objects, the students get a better and more robust understanding of the concept and it also help the facilitators in explaining in a more practical manner.[11,12] In terms of medical field, the limited literature based on AR integration in education is related to the medical students and surgical trainees.[13,14] The participants in the present study were HCPs who are less commonly involved in such technology-driven activities. Our results were consistent with better learning, more curiosity, and a strong recall.

We found that AR was an exceptionally useful tool for marketing campaigns compared to the traditional paper-based campaigns. It was observed that approximately four-fifth of our study population claimed AR to be more effective for brand recall compared to not only the traditional paper-based campaigns but also the common digital campaigns. About the similar percentage of study participants were positive about prescribing a standard drug to their patients with hypertension. This antihypertensive agent for patients enable them to achieve therapeutic blood pressure goals on monotherapy or as an initial therapy in patients who are more likely to require combination therapy for achievement of therapeutic goals of blood pressure.[15]

Mauroner et al.[5] performed an experimental study to evaluate the AR as a useful tool for advertisement and improve the customer experience. Similar to the findings of this study, they found that AR added the interactive component to the customers' overall experience enhancing their perception and significantly improving the credibility of the brand. It highly influenced the brand recall and therefore leading to a much better and more impactful processing of the brand message. AR provides a combination of printed advertisement and VR experience subsequently providing the client with the product relevant experiences.

In pharmaceutical marketing, application of virtual, extended, and AR technology is still a budding concept. VR has gained popularity as physicians find it more engaging as compared to websites and other clinical

tools.[16] These technologies allow pharmaceutical marketers to communicate with their clients in a unique manner, understand their learning patterns, prescribing habits, and assess their knowledge needs. AR and VR provides multi-sensory three-dimensional environments for more effective message delivery.[16]

The participants of the present study also reported AR to be captivating and entertaining with a good impact on learning and brand recall and an overall positive experience in learning about hypertension. Previously, the literature has reported the utilization of digital technology and AR for enhancing disease-related education and non-pharmacological self-management strategies in hypertensive patients,[17,18] however, the authors could not find literature enhancing HCPs knowledge about hypertension using digital technology, AR, or VR.

PharmEvo (Pvt.) Limited is a healthcare company involved in pharmaceutical products, medical equipment, and infant formula. Its core values include integrity, trust, and respect. Only recently, PharmEvo has collaborated with the University of Health Sciences, Lahore to launch an online portal for initiating medical and dental educational [Continuing medical education (CME)/ Continuing dental education (CDE)] courses for HCPs across Pakistan to enhance their professional capacity.[19]

Conclusion

AR is a modern technology. It is capable of presenting a fine blend of real and virtual environments. It is being moderately explored in education and marketing. AR contributes greatly to information retention, enjoyable experience, and a more practical and realistic approach to theoretical concepts in education as well as allowing customers to have a more personal and communicative experience with the brand enabling a positive attitude which results in higher customer satisfaction.

Limitations of the study

AR is still a novice marketing tool but has proven to be very effective by the limited data we have so far. Nevertheless, the use of AR technology can be limited by many factors. One of the limitations we encountered during the study was that the more experienced - senior faculty/health-care practitioners did not find AR easy to use. Similarly, in many areas, there was unavailability of Internet access or the participant's devices did not have a supporting webcam. We were also hindered by the fact that many mobile phones did not support AR applications. Therefore, such factors and limitations must be kept in mind when designing AR programs for marketing purposes.

Acknowledgement

List of Abbreviations

AR	Augmented reality
HCPs	Healthcare professionals
VR	Virtual reality

Conflict of interest

None to declare.

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Ethical approval

Procedures and questionnaires for survey have been reviewed and approved by the Institutional Review Board (IRB) of the Demographic and Health Surveys (DHS) Program vide IRB#: DSH/ RIB/2020/0015 dated 25-04-2020.

Authors' contributions

MJ: Conception and design of study and questionnaire, drafting of manuscript.
ZS, AS, UK: Acquistion and analysis of data, drafting of manuscript, critical revision of the manuscript for important intellectual content.
ALL AUTHORS: Approval of the final version of the manuscript to be published.

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