

# USERS' AWARENESS OF AUGMENTED REALITY TECHNOLOGY IN MOBILE APPLICATIONS

ROZPOZNAWALNOŚĆ TECHNOLOGII ROZSZERZONEJ RZECZYWISTOŚCI  
W APLIKACJACH MOBILNYCH PRZEZ ICH UŻYTKOWNIKÓW

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## ABSTRACT

Augmented reality (AR) is becoming an increasingly popular technology, used in many fields. Particular prospects for its development are inherent in the dissemination of AR-based applications on widely used mobile devices. To guide the emerging research in this field, the level of knowledge of AR technology among potential consumers needs to be identified. The aim of this study was to determine the level of awareness of AR in mobile applications among their potential users, attempting to determine whether it is possible to define the profile of a user characterized by a greater level of knowledge of AR. Statistical analysis of the results of original research carried out with the CAWI in the spring of 2020 showed that the knowledge of augmented reality technology among potential consumers is at a relatively low level. Moreover, this study found no characteristics correlated with this knowledge, in terms of either demographics, or interest in and knowledge of modern technologies in general.

**Key words:** Augmented reality, mobile applications, technology awareness, questionnaire research, marketing

## ABSTRAKT

Rozszerzona rzeczywistość (AR, augmented reality) staje się coraz popularniejszą technologią, która znajduje swoje zastosowanie w wielu dziedzinach. Szczególne perspektywy jej rozwoju wiążą się z upowszechnieniem opartych właśnie na AR aplikacjach na wykorzystywanych szeroko urządzeniach mobilnych. By móc ukierunkować powstające badania dotyczące tej dziedziny, niezbędne jest rozeznanie poziomu znajomości tej technologii przez potencjalnych konsumentów. Celem niniejszej pracy jest określenie poziomu rozpoznawalności rozszerzonej rzeczywistości w aplikacjach mobilnych przez ich potencjalnych użytkowników wraz z próbą określenia czy możliwe jest określenie profilu osoby charakteryzującej się większym poziomem znajomości AR. W pracy zaprezentowane zostały wyniki autorskiego badania wykonanego metodą wiośną 2020 roku. Przeprowadzona analiza statystyczna tychże wyników wykazała, iż znajomość technologii rozszerzonej rzeczywistości przez potencjalnych konsumentów jest na dość niskim poziomie, zaś dodatkowo nie występują charakterystyki skorelowane z tą znajomością zarówno w odniesieniu do demografii jak i zainteresowania oraz znajomości nowoczesnych technologii ogółem.

**Słowa kluczowe:** Rozszerzona rzeczywistość, aplikacje mobilne, znajomość technologii, badanie ankietowe, marketing

JEL: D12, M31, O31

## Introduction

One of the most noticeable trends in contemporary marketing is the growing popularity of mobile devices. It is estimated that in 2019 there were over 5.1 billion unique mobile phone users, representing global market penetration of 67% (We Are Social, 2019). These data are particularly important when compared to the corresponding statistics from 2014. Just 4 years earlier, the number of unique mobile phone users was estimated at 3.7 billion, which represented global market penetration of 51% (We Are Social, 2015). This means that approximately 1.4 billion potential consumers of mobile marketing content joined the market over the course of just 4 years. In terms of the Polish market, in 2020, smartphone users accounted for an estimated 83.35% of the population, while only 5 years earlier the figure was

50.55% (Sas, 2020). In particular, the potential of smartphones in mobile marketing is demonstrated by studies such as Gemius (2020) — a survey conducted in March 2020, showing that as many as 69% of respondents used mobile devices for online shopping, and interestingly, that this share was identical for women and men. In terms of specific age groups, among the 25–34 age group the share of mobile users was already 80% and almost equalled the declared use of laptops for online shopping (81%), while in the 15–24 age group, 92% of respondents used a smartphone to buy online. The latter was the only age group that declared that they used such devices more often for purchases than portable computers (ibid.).

Such rapid growth in the mobile device market has translated directly into the development of new mobile marketing tools created with the use of emerging technologies, both in Poland and around the world. Research conducted by Polish scientists has distinguished such marketing tools as mobile applications, mobile versions of websites, NFC payments, Quick Response (QR) codes, mobile coupons, beacons, geolocation services, gamification, virtual reality and *augmented* reality (Smołucha, 2017; Gregor i Gwiaździński, 2019).

This article focuses on the last of these tools — augmented reality. The surging interest being shown in this technology by researchers seems well-founded, as according to the 2018 Gartner report (Gartner, 2018) it should come into widespread productive use within 5–10 years. Moreover, research in the field of marketing suggests that augmented reality can significantly affect decisions made by consumers (Javornik, 2016; Yim et al., 2017). In the available literature, however, there is little research related to the recognition of AR technology by its target audience. While there are studies that indicate the level of this recognition in relation to mobile applications (Gregor and Gwiaździński 2019, Szymczak 2019) or wearable devices (Gregor and Gwiaździński 2020), these studies did not attempt to determine whether this indicator can be correlated with specific characteristics of the respondents. The objective of present study is to fill this research gap to some extent.

This paper aims to determine the level of knowledge of augmented reality technology in mobile applications among its potential users. Additionally, the analysis aims to identify the characteristics of people with good knowledge of AR.

Based on the available literature on the subject (including both scientific research and industry reports), a research tool in the form of a questionnaire was constructed and an original survey was conducted on its basis, the results of which are presented in this article. The study was carried out using the CAWI method in March and April 2020, using the Google Forms tool. The questions asked in the survey were answered by a total of 306 respondents, mostly students and graduates of the University of Economics in Poznań and the University of Life Sciences in Poznań. The vast majority of respondents belonged to the group of potential recipients of the technology in question, and so the findings presented herein may serve as the subject of further analysis.

The following parts of the article contain, in turn, a description of the augmented reality technology and its development, recognition of this technology, the research methodology, the results of empirical research, as well as discussion and conclusions.

## **Development of augmented reality**

The beginning of work on augmented reality dates back to the 1960s, when the first devices using the technology of combining real and virtual images were developed. The first devices based on this concept were similar in operation to later video helmets (HMD — head-mounted display) (Sutherland, 1968). In the following decades, work on augmented reality focused on concepts and prototypes. For example, in the mid-1970s, Myron Krueger and his team developed the concept of an "artificial reality" laboratory, which was intended to enable the user to create virtual images by means of actions in the real world. The applied solutions made it possible, for example, to draw on a virtual blackboard with a finger or to manipulate a circle through gestures (Krueger et al., 1985).

The term "augmented reality" first appeared in the scientific literature in the early 1990s, when Thomas Caudell and David Mizell described the solution they used at Boeing. As they wrote, the technology they studied was used to expand the user's visual sphere with relevant information (Caudell and Mizell, 1992). This is where the description of such a solution as augmented reality comes from. The augmented reality (AR) concept was

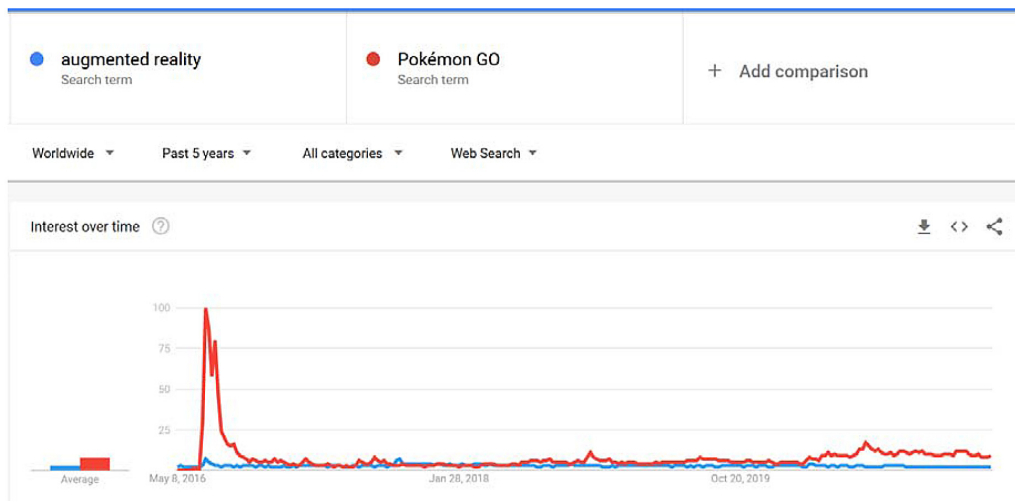
more precisely described by Milgram and Kishino (1995). In their work, they described the "virtuality continuum", in which they clearly indicated that AR is an environment similar to a representation of the real world, which is created by enriching the real image of the world with some virtual elements. There they strongly distinguished between augmented reality and virtual reality, describing the latter as the creation of a completely virtual environment augmented by elements of the real world.

Augmented reality is a technology that requires the use of an appropriate hardware platform to function properly. Back in the 1990s, Milgram and Kishino stated that the concept that best described the essence of augmented reality was the above-mentioned HMD. However, with the development of computer technology in accordance with Moore's law (Moore, 1965) and the attendant miniaturization, possibilities of using augmented reality on mobile devices appeared. In addition, the popularization of augmented reality on smartphones and tablets was facilitated by the emergence of a duopoly on the market of mobile operating systems: in 2012, the share of the two main systems — iOS and Android — exceeded 50% of the market, to reach over 90% in 2016 (Statista 2019). Thanks to this, developers of applications using AR who want to reach out to a majority of users of mobile devices need only to develop their product for the two platforms mentioned. What is more, the producers of the above-mentioned mobile operating systems have realized the potential of augmented reality technology and joined work on it by preparing toolkits (SDKs — software development kits) allowing for easier building of AR-based applications. Thus, in 2017, Apple first presented the initial version of the ARKit package (Potuck, 2017), and in the same year, Google introduced its ARCore package (Amadeo, 2017).

The huge growth opportunities of augmented reality are also indicated by industry forecasts and reports. For example, in the report from 2018, Gartner indicated that AR may be mentioned as one of the technologies with significant development opportunities, and that it would enter the stage of widespread productive use within 5 to 10 years (Gartner 2018). In turn, the value of the augmented reality market in the coming years, depending on the source, is forecast at up to \$198 billion (Financialnewsmedia.com, 2020). It should be noted, however, that AR has a relatively short period of experience in the broad market, which is

associated with relatively little popularity. According to the quoted Gartner report (2018), currently work on it is at the "Trough of Disillusionment" stage, which, according to the authors means that the burden of work on this technology focuses on making the use of AR more realistic by minimizing the weaknesses of this solution.

This dynamic development is associated with ongoing implementations of augmented reality in many industries. Medicine can be cited as an example — a paper by Martin Eckert et al. (2019) described 338 scientific publications dealing with the subject of augmented reality in the field of health care. Importantly, many of them described systems already operating or at the stage of an advanced prototype. Another example is the use of augmented reality in engineering to install, maintain or repair devices. Palmarini et al. (2018) cited 30 scientific papers describing the use of AR in device maintenance alone. The prospects for using augmented reality in tourism are also promising. As described by Moro et al. (2019) 40 scientific papers per year were already being written on this topic since 2013, while in 2017 there were 75 papers published. When describing the applications of augmented reality, it is also impossible to omit entertainment and education. Jingya Li et al. (2017) described 26 scientific articles describing the use of AR games in education. A fundamental step towards broader popularity of augmented reality came when by the mobile game Pokémon GO became a global phenomenon. It was the first time that an AR-based application broke into the broadly understood mainstream — within 3 months of its release, the game was downloaded 550 million times, which generated revenue of nearly half a billion dollars (Wagner et al., 2017). The interest in the above-mentioned game, which was based on the concept of catching virtual pokémon while walking around the real world, at its peak repeatedly surpassed the interest in augmented reality as such, which may be seen with the use of the Google Trends tool (Figure 1). Interestingly, as both these statistics and the presented financial data show, the popularity of Pokémon GO in the following years has not disappeared, and is even starting to recover (Iqbal, 2020).

**Figure 1. Interest in terms "augmented reality" and "Pokémon GO" in Google**

Source: <https://trends.google.com/trends/explore?date=today%205-y&q=augmented%20reality,Pok%C3%A9mon%20GO> [retrieved 05.05.2021].

## Augmented Reality in Marketing

Particularly importantly in the context of this paper, there are also numerous applications of augmented reality in marketing. For example, a systematic literature review conducted in 2019 (Yusof et al., 2019) found 89 publications describing primary research on marketing communication using AR in the context of buyer behaviour and perception. The most frequently cited works in this field refer to the possibility of using augmented reality in marketing (Bulearca and Tamarjan, 2010), its acceptance by users (Rese et al., 2017) and most importantly, the impact of the use of this technology on user behaviour (Javornik, 2016; Yim et al., 2017). The literature also provides descriptions of individual AR implementations in marketing applications. These include false window type (bogus window) solutions, which work like a panel mounted on the walls of bus stops, for instance, displaying an image on it enhanced with some virtual elements (Scholz

and Smith, 2016). Another example of the marketing use of AR is the IKEA Place application for smartphones and tablets, created in 2017. It makes it possible to superimpose virtual avatars of products from the IKEA catalogue available in this application on the camera image of a mobile device (Alves and Reis, 2020). According to data for July 2020, this application has been rated approximately 5,500 times on the App Store and almost 1,500 times on Google Play, and the number of downloads in the Google application store has exceeded 100,000 (Apple does not provide information on the number of application downloads). Interestingly, IKEA has already tried to use augmented reality in its applications before. The 2013 catalogue for the next year included graphics which, after being scanned via a mobile device, turned into three-dimensional models of the Swedish company's products on the screen (Tabusca, 2014). Another example of a marketing application, but with direct connection with the possibility of making purchases, is the Sephora drugstore app. The Virtual Artist functionality available in it allows customer to virtually apply a selected range of cosmetics to an image of their own face, captured in real time by the front camera of a smartphone or tablet. Importantly, the application also allows the tested cosmetics to be purchased. As indicated by the conclusions of the research, the application has a significant impact on the attitude of consumers to the brand (Scholz and Duffy, 2018; Santulli, 2019). The LEGO Playground application, which was made available for Apple smartphones and tablets in 2018, can be used as an example of the marketing use of augmented reality to expand the consumer experience. This application allows for additional fun with purchased LEGO sets by transferring specific blocks to the smartphone screen and animating them (Figure 2.). Thanks to this, after purchasing a set for building a castle, for example, it was possible to carry out its siege in the application (Vacante, 2018). As shown by research, the technology used has inspired consumers both psychologically and behaviourally (Hinsch et al., 2020).



**Figure 2. The LEGO Playgrounds application in use**



Source: <https://www.lego.com/pl-pl/aboutus/news/2019/october/lego-playgrounds/> [accessed 31 October 2020].

The popularity of AR in marketing applications has translated into the coining of the term Augmented Reality Marketing (ARM). According to the definition found in the literature, ARM refers to any means of creating or integrating communication and distributing digital elements (information or objects) in a real physical environment in order to:

- improve the customer experience and influence the decision-making process (Chylinski et al., 2020).
- disclose, demonstrate or articulate specific benefits to consumers (Rauschnabel et al., 2019; Hinsch et al., 2020).
- improve relations with consumers, increasing their loyalty and satisfaction (Dadwal and Hassan, 2016).

As researchers point out, marketing focused on augmented reality allows consumers to be influenced through nostalgia and the "wow effect" (Hinsch et al., 2020), inspiration (Rauschnabel et al., 2019) or the ability to utilize digital affordances (opportunities to influence) in real-world environments (Chylinski et al., 2020).

## **Awareness of augmented reality**

As previously mentioned, augmented reality is a cutting-edge technology that has yet to reach its peak of popularity. On the other hand, as outlined above, successful implementations of augmented reality in mobile applications are currently under development. For example, the above-mentioned IKEA Place and Sephora applications are available for download and use as of April 2021, including on the Polish market. Therefore, a question arises about the actual awareness and recognition of the augmented reality technology among end consumers. This issue is important because the level of user experience is one of the main components of many models of technology acceptance, which researchers refer to when describing the use of augmented reality and its perception by consumers. Examples include the TAM2 (Venkatesh and Davis 2000) and UTAUT (Venkatesh et al. 2003) models. Moreover, the level of consumer knowledge about a given technology allows for conclusions about further perspectives of consumer conviction and finally its implementation and acceptance, in accordance with the theory of diffusion of innovation (Rogers, 2003).

Research on the level of knowledge of a given technology is of particular importance at a time when it is at the stage of early development and only gaining popularity. This is when they may contribute most to further progress in relation to a given technology. Such research has been carried out in Poland in relation to marketing, such as regarding the Internet of Things (IoT) technology and Artificial Intelligence (AI) (Kaczorowska-Spychalska, 2018) or artificial intelligence in marketing communication (Gwiaździński, 2018). Regarding augmented reality, A. Szymczak (2019) asked in her research about the use of this technology, also asking about the advantages of using AR and VR (virtual reality) together. The survey

showed that 48% of 114 respondents used augmented reality, including 26% who used it regularly. However, declarations of this technology's recognizability were not taken into account, and the profiles of people using augmented reality were not analysed. The existing literature includes studies that asked about the awareness of AR in contrast to other mobile marketing tools. For example, a study conducted on the Polish market by Gregor and Gwiaździński (2019) found that slightly more than half of the respondents knew of this technology, which was a worse result compared to mobile coupons, QR codes or mobile social networks, but comparable to familiarity with NFC payments or beacons. Another study, also under Polish conditions, indicated that about two-thirds of the respondents declared knowledge of augmented reality in the form of AR glasses (Gregor and Gwiaździński, 2020).

## Research methodology

Following the literature review, it was decided to conduct a study that could answer the question "What is the awareness of augmented reality among potential consumers?". The study was extended to consider a number of traits, the possible correlation of which with the level of knowledge of augmented reality could indicate what characterizes people better familiar with AR technology. A set of hypotheses was formulated in relation to the study. The first concerned the level of awareness of augmented reality among potential consumers — it was assumed that this level is low. Hypotheses were also formulated regarding the positive correlation of knowledge of AR with interest in new technologies, involvement in learning about them, and knowledge of mobile applications and skills to use them. Additionally, a hypothesis was formulated regarding the lack of correlation of the demographic characteristics of consumers, such as age, education or place of residence, with the knowledge of augmented reality.

The study was conducted using the CAWI method using the Google Forms platform, thus in a similar way as one of the previously cited studies (Gregor and Gwiaździński, 2019). The survey was addressed mainly to potential recipients of augmented reality technology, i.e. young adults,

mostly university students or graduates. The target group was therefore similar to the previous research on the recognition of modern marketing tools (Gregor and Gwiaździński, 2020). The survey was active for 31 days from the end of March to the end of April 2020. The questionnaire was distributed mainly through social media, by e-mail and using distance learning channels available to students. Language of the survey was Polish.

## **The results of the empirical study**

The survey was closed after receiving 306 responses. In line with the assumptions, the vast majority of respondents were young adults — 62% of respondents declared their age in the range of 19–24 years, and a further 30% in the range of 25–35 years. Also in line with the earlier assumptions, most of the respondents were university students (66%) or graduates (24%). Regarding the place of residence, 42% declared that they resided in a city with a population of more than 250,000 inhabitants, 25% indicated that they lived in smaller towns, and 32% answered that they lived in the countryside. Most of the respondents were women (63%), with men in the minority (37%). Due to the characteristics cited here, this sample cannot be considered representative for Poland, but it should, to a large extent, correspond to the profile of a potential augmented reality user. To further emphasize this match, part of the analysis described below was carried out in two ways: with reference to the entire sample, or only to the 19–24 age group.

Based on the data collected through the survey, a statistical analysis was performed using the SPSS® statistical package by IBM and the tools of the Google Forms platform on which the study was conducted. Two questions were asked to determine the degree of consumer awareness of augmented reality. The first question asked about the knowledge of the term "augmented reality" itself. 28.2% of the respondents stated that they knew very well what AR was, and a further 30.8% had encountered this term, but did not know exactly what this technology was. Importantly, in the 19–24 age group alone, which, as already mentioned, may be considered the target group of recipients of AR applications, these results were similar: 26.2% of people declared that they knew well what AR was, while 31.6% had met

with this term, but its meaning was uncertain to them. The second question concerned awareness of the use of augmented reality by several applications that have been previously listed — Pokémon GO, Ingress/Ingress Prime, IKEA Place, Houzz, Sephora (Visual Artist option described earlier), Snapchat (filters that change the appearance of the user's face) and Instagram (filters that change the appearance of the face and the ability to try products on one's own face). The respondents placed their answers on a 7-point Likert scale, where the lowest score was additionally described as the answer "no, I had no idea", and the highest score was described as "yes, I knew it well". This choice of scaling technique was dictated in line with the suggestions in the existing literature (Tarka, 2015), by a desire to be able to differentiate the answers to the given question to the greatest possible extent. The responses averaged 3.33 points (3.29 in the 19–24 age group alone), and the median was 3 points. Importantly, however, the dominant, and therefore the most frequently indicated answer was the lowest score of "1", described as a complete lack of knowledge about the use of the mentioned AR applications — it accounted for 35.4% among all respondents and for 34.2% among the 19–24 age group. On the other hand, the second most frequent answer was the highest score — given by 13.6% of the respondents. Therefore, despite the use of the 7-point Likert scale, extreme answers were obtained most often (Figure 2).

The correlation between the answers to the above-mentioned questions and the remaining questions was examined by calculating the Kendall Tau-b coefficient, due to the distribution of answers in both cases being significantly different from the normal one. On this basis, it was found that the only case where a high correlation could be said to exist occurred between the answers to the questions on knowledge of the term "augmented reality" and on awareness of the use of AR in the cited applications. In this case, the Kendall Tau-b coefficient was 0.58 with a significance  $p < 0.05$ . In other cases, significantly lower values of this coefficient were recorded. The second strongest correlation that was noted concerned the question about the interest in emerging new technologies, but also in this case we can speak about a rather weak correlation: the value of the coefficient was 0.31 regarding the knowledge of the term AR and 0.28 regarding the awareness of the use of AR by the mentioned applications (in both cases, the significance was  $\alpha < 0.05$ ). Values exceeding

0.25 (but less than 0.3) were noted for questions about the ability to use various mobile applications, proficiency in using various new technologies and knowledge of the Pokémon GO application (the significance in each case was  $\alpha < 0.05$ ). For the remaining questions, even lower values were recorded (e.g. place of residence, frequency of online purchases) also in combination with a significance level higher than  $\alpha < 0.05$  (e.g. age or education) (Table 1).

In addition, the survey categorised the responses according to varying degrees of fit with the previously described pattern of the potential audience for augmented reality technology in mobile shopping applications. Factors such as age, education, interest and proficiency in using new technologies or ability to use mobile applications were taken into account together. When considering this distribution across the different options, a correlation measured by Kendall's Tau-b coefficient of no more than 0.3 was achieved

Additional results may be presented in relation to the knowledge of particular augmented reality applications. The aforementioned literature references about the phenomenon of the Pokémon GO game were confirmed, with over 3/4 of the respondents declaring that they had heard about this application. Significantly, however, only less than 24% answered that they had used this application. A much better result was achieved in the case of the functionality of face-changing filters — in the case of both Snapchat and Instagram, more than half of the respondents declared that they used these possibilities. A significant group of people also declared knowing (36%) or using (27%) the Instagram functionality that allows them to "test" products on their own face. The other applications were much less popular. While many people have heard about the IKEA Place and Sephora (Virtual Artist) applications — 46% and 27% respectively, they have actually been used by much fewer people — about 10% of respondents each. On the other hand, the Ingress and Houzz applications were poorly recognizable and were used to a minimal extent by the respondents (Chart 1.).

**Table 1. The results of the empirical study — correlations between the respondents' answers to individual questions**

|   |                         | Have you come across the term augmented reality (AR)? | Did you know that the applications mentioned above use augmented reality? |
|---|-------------------------|---|---|
| Have you come across the term "augmented reality" (AR)?   | Correlation coefficient | x   | .577**  |
|   | Relevance               | x   | 0,000   |
| Did you know that the applications mentioned above use augmented reality?                           | Correlation coefficient | .577**  | x   |
|   | Relevance               | 0.000   | x   |
| How would you rate your general interest in emerging new technologies?                              | Correlation coefficient | .309**  | .274**  |
|   | Relevance               | 0.000   | 0.000   |
| How would you rate your commitment to learning about emerging new technologies?                     | Correlation coefficient | .219**  | .216**  |
|   | Relevance               | 0.000   | 0.000   |
| How would you rate your proficiency in using various new technologies?                              | Correlation coefficient | .245**  | .251**  |
|   | Relevance               | 0.000   | 0.000   |
| How would you describe your knowledge of the various mobile applications available for smartphones? | Correlation coefficient | .226**  | .206**  |
|   | Relevance               | 0.000   | 0.000   |
| How would you describe your ability to use various mobile applications available for smartphones?   | Correlation coefficient | .228**  | .251**  |
|   | Relevance               | 0.000   | 0.000   |
| How often do you use different mobile applications?   | Correlation coefficient | .159**  | .117*   |
|   | Relevance               | 0.001   | 0.014   |
| What device do you use more often to browse the Internet?   | Correlation coefficient | -.146**   | -.124**   |
|   | Relevance               | 0.003   | 0.009   |
| How often do you shop online?   | Correlation coefficient | .191**  | .136**  |
|   | Relevance               | 0.000   | 0.003   |
| What device do you use more often for online shopping?  | Correlation coefficient | -0.001  | 0.003   |
|   | Relevance               | 0.979   | 0.946   |



Cont. table 1

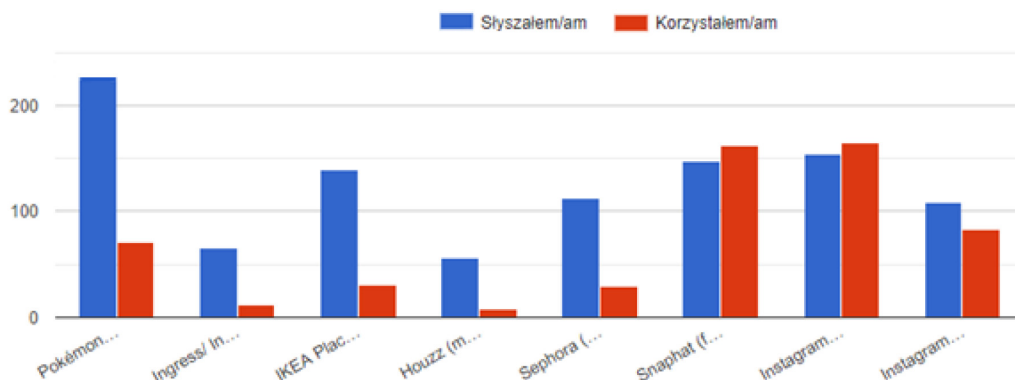
|  |             | Have you come across the term augmented reality (AR)? | Did you know that the applications mentioned above use augmented reality? |
|--|-------------|---|---|
| How often do you make purchases in mobile applications?  | Correlation | .100*   | .126**  |
|  | Relevance   | 0.034   | 0.006   |
| If you buy via a mobile device, do you use applications with a purchase function or a website in your browser more often?              | Correlation | .100*   | .103*   |
|  | Relevance   | 0.033   | 0.023   |
| Tick below the apps you have used or heard of. [Pokémon GO]  | Correlation | .251**  | .255**  |
|  | Relevance   | 0.000   | 0.000   |
| Tick below the apps you have used or heard of. [Ingress/ Ingress Prime]  | Correlation | .109*   | .138**  |
|  | Relevance   | 0.035   | 0.006   |
| Tick below the apps you have used or heard of. [IKEA Place (IKEA articles in the user's room)]   | Correlation | .101*   | .133**  |
|  | Relevance   | 0.047   | 0.007   |
| Tick below the apps you have used or heard of. [Houzz (furniture and accessories in the user's room with the possibility of purchase)] | Correlation | 0.045   | 0.077   |
|  | Relevance   | 0.386   | 0.130   |
| Tick below the apps you have used or heard of. [Snaphat (face changing filters)]   | Correlation | .118*   | .130**  |
|  | Relevance   | 0.020   | 0.008   |
| Tick below the apps you have used or heard of. [Instagram (face changing filters)]   | Correlation | 0.081   | .180**  |
|  | Relevance   | 0.114   | 0.000   |
| Tick below the apps you have used or heard of. [Instagram (the possibility of trying the products on your own face)]                   | Correlation | 0.000   | 0.071   |
|  | Relevance   | 0.994   | 0.143   |
| Age  | Correlation | 0.011   | 0.009   |
|  | Relevance   | 0.832   | 0.863   |
| Tick below the apps you have used or heard of. [Sephora (Visual Artist option — the ability to test the makeup on the user's face)]    | Correlation | 0.007   | 0.088   |
|  | Relevance   | 0.895   | 0.074   |
| Place of residence   | Correlation | .110*   | .104*   |
|  | Relevance   | 0.024   | 0.028   |
| Education  | Correlation | 0.073   | 0.068   |
|  | Relevance   | 0.142   | 0.158   |

Source: Own data



### Chart 1. Respondents' answers about knowledge and use of selected AR applications

Zaznacz poniżej aplikacje o których słyszałeś/aś lub korzystałeś/aś z nich.

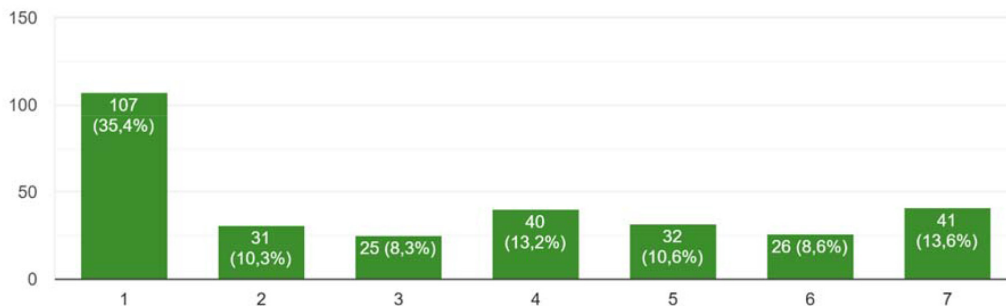


Source: Own data with the use of Google Forms.

### Chart 2. Respondents' answers regarding awareness that the mentioned applications use augmented reality

Czy wiedziałeś/aś, że aplikacje wymienione powyżej korzystają również z rozszerzonej rzeczywistości?

302 odpowiedzi



Source: Own data with the use of Google Forms.

## Discussion and conclusions

Overall, this study showed that awareness of augmented reality among the surveyed group of consumers is relatively low. Only 28% of the respondents declared that they knew very well what AR was, and another 31% had encountered this term, but did not fully know what augmented reality was. Moreover, after citing a few examples of applications using AR, the respondents indicated that they were rather poorly informed that these applications use this technology — on average they indicated 3.33 points on a scale from 1 to 7. However, answers regarding recognition and use of specific applications varied — the vast majority of respondents have heard about Pokémon GO, and more than half used the functionality of face-changing filters. Taking into account the answers to all the questions, it should be stated that these consumers are, de facto, using AR technology to some extent unconsciously.

On this basis, we can speak of a partial confirmation of the main hypothesis of the study, regarding a low level of recognition of such technology — while a total of 59% of respondents had encountered the term "augmented reality", only 31% declared that they had a good understanding of what AR was. These conclusions are to some extent consistent with the research conducted so far. For example, in the study by Szymczak (2019), 48% declared using augmented reality, and in the study by Gregor and Gwiaździński (2019), knowledge of AR was declared by 52% of respondents. In contrast, in a study conducted in 2020 by the same authors (Gregor and Gwiaździński 2020), knowledge of the technology of augmented reality glasses was declared by 67.6% of respondents, but only 6.4% actually used these devices. This situation is similar to the study described in the present article below — in the case of applications such as Pokémon GO, Houzz, Ingress or IKEA Place, the declared knowledge of the application was much higher than the declared use of them (Chart 1.). On the other hand, the low popularity of AR applications that make a purchase (Houzz, Sephora) presented in the study is consistent with the results of the Dacko (2017) study from the American market: out of over 10,000 surveyed smartphone users, only 10.7% declared that they used a shopping application with augmented reality.

The lack of even a moderate correlation between the declared knowledge of the term "augmented reality" and recognition of this

technology and the answers to all other questions in the survey was somewhat surprising. Thus, the hypotheses on the relationship between the declared knowledge of AR and, among other factors, interest in new technologies or the ability to use mobile applications were not confirmed. On the other hand, the hypotheses that there is no relation to the aforementioned declarations of such characteristics as age, education or place of residence were certainly confirmed. However, a gender gap was found in terms of declared knowledge of the term "augmented reality": 39.6% of men declared that they knew well what AR was, and a further 26.1% indicated that they had come across this term, but did not know exactly what it meant, whereas the corresponding rates for women were 21.4% and 33.16%. Thus, women more distinctly more often indicated that they had encountered this term, but were not sure of its meaning, while men much more often declared that they knew what it meant. Similarly, in the case of the Dacko study (2017), men more often declared that they used AR applications (11.6% compared to 9.6% in women), while women more often indicated uncertain answers due to insufficient knowledge of augmented reality technology (50.2% versus 37.1% in men). This is an interesting topic that requires further research to better understand the cause of the gender differences in perception.

The study presented here may constitute a prelude to further research in this area, such as to further scrutinize the main findings presented herein: namely, that there is no clear profile of a person well acquainted with the technology of augmented reality, and that many people actually use augmented reality without conscious awareness of this technology. Further research on knowledge and use of AR in mobile applications may focus on specific types of applications. Based on the presented results (Chart 1), it can be assumed that mobile games and social media applications that use filters that change the appearance of faces, such as Snapchat or Instagram, have remarkable potential in this regard. Additionally, in research expanding knowledge on this issue, it is worth considering what the key reasons are for the acceptance of the described technology by consumers. This will allow the key aspects of the further development of this type of application to be better identified.

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