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Issue **Article**

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DIGITAL DIVERSIFICATION AND THE PROSPECT OF USE OF IMMERSIVE TECHNOLOGIES IN THE EDUCATIONAL PROCESS (TO THE PROJECT OF MODERNIZATION OF ONMU CRIMINOLOGICAL & CRIMINALISTICS LABORATORY)

Abstract: *The article substantiates why digital diversification accompanied with the prospect of use of Immersive technologies will make positive transformational impact on the whole educational process, and its separate areas. To show that, here I intend to highlight the project of modernization of 'ONMU criminological & criminalistics laboratory', within the concept of collaboration between educational and IT sectors. This modernization is possible by implementing technologies of VR, AR, MR, and building appropriate XRL infrastructure. Summarizing this study, I support the opinion that with the development of virtual reality technologies, augmented reality, and especially the wider use of immersive technologies in the equipment of forensic training grounds (or criminalistics polygons, taken as an illustrative sample), we will face their growing digital diversification, and popularity of their virtual analogues, as well as spaces where the AR, XR concepts are widely implemented. To strengthen this statement, I point at the following advantages of using virtual analogues: lower cost of maintaining virtual criminalistics polygons and supporting their functioning; logistics benefits for students and trainers; almost unlimited possibilities for modeling, changing, improving, expanding virtual models of forensic polygons (i.e. diversifying the view of the simulated spaces, changing the conditional scene of the incident, varying circumstances, features, tools and means of committing modeled delinquencies). At this stage, we can talk about the need to determine three levels of implementation of immersive technologies in the educational process: sectoral, technological, infrastructural.*

Key words: *reality, virtuality, immersive technologies, education, interdisciplinary collaboration, criminalistics polygon, digital environment.*

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Introduction

This world is all about communicating and connecting people together. We feel this especially keenly here in Ukraine. Today Ukrainians are suffering a full-scale war experience, but along with that, the entire Free World is supporting Ukraine, and the importance of all kinds of communication cannot be overestimated.

A lot of new technologies (being implemented into daily life) make us live in a world of experience driven global connectivity. This is especially true for immersive technologies, virtual, augmented, mixed, and extended reality models. With their development, we acquire a new opportunity to bridge different communication and comprehension gaps through direct experience.

Virtual reality has become a special subject for **ontology**, since immersive technologies, augmented reality and other virtual technologies showed the ability to supply us practical tools and access to data, making influence on content consumption (based on how we experience it, how we feel and understand that content). Some researchers and publicists even say that with the rise of virtual and augmented reality technologies the "information age" has turned into "imagination age". In Ukraine (as well as in most other technologically advanced countries), today we are dealing mainly with virtual communication tools, with 3D-modeling products, with distance education platforms, with developed e-banking, electronic commerce, but only with particular elements of augmented reality (mostly with regard to navigation, touristic and museum infrastructure, some projects in the IT sector). However, the scope of augmented reality technologies is much comprehensive.

Augmented reality technologies can be used virtually in any sector like education, entertainment, tourism, logistics, medicine & medical training, military training, navigation, repair & maintenance, architecture, archaeology, energy industries, public safety, social interaction, shopping, and for many other purposes.

The purpose of the study

This article has a practical-oriented objective: to introduce the creative possibilities of immersive technologies, and to prepare mental preconditions for potential stakeholders taking part in the project of modernization of "ONMU criminological & criminalistics laboratory", by leveraging augmented reality (AR), mixed reality (MR), virtual reality (VR), extended reality (XR) tools. The main accent in such modernization should be done on the introduction of Extended Reality Learning (XRL) infrastructure. I'm going to present main benefits of digital diversification of educational space, on example of possible introduction of XR technologies into some training facilities like a criminalistics polygon.

Theoretical and methodological framework

Methodology of the research is based on formal logical methods of analysis and synthesis, on a comparative description method, and an axiological approach. To clarify the possibilities of immersive technologies and techniques in the educational and other crucial social-economic sectors, methodologically important is to draw some attention to previously published works dedicated to related issues. Among them it could be mentioned the works, which focused on: a taxonomy of Mixed Reality (Milgram & Kishino, 1994); the effect of immersive technology on user presence (Cummings & Bailenson, 2015); everyday experiences of datafication (Kennedy, 2018); emotions in everyday engagements with data and their visualisation (Kennedy & Hill, 2018); data visualisations (Kennedy et al., 2021); issues of human-computer interaction, user experience and virtual reality (Penichet et al., 2013); personal life experiences shaped by technologies (Reeves et al., 2019); the problem of innovation (Stovpets, 2016; Stovpets, 2017); some ethnographic aspects to what extent a nation can be open to the perception of technologies (Stovpets, 2020); interconnections of augmented reality, law, privacy, and ethics (Wassom, 2015).

The presentation of main ideas, results and discussion

For those unfamiliar with the above mentioned notions (like VR, AR, MR, XR, immersive technologies), I have to place some brief explanations. All these definitions were formulated both in scientific and journalistic publications. The following is a concise overview of the most typical interpretations of adverted concepts.

Virtual reality (VR) is a fully enclosed digital environment that replaces the user's real world environment. In other words, virtual reality is a simulated experience that can be similar to or completely different from the real world. Other distinct types of VR-style technology include augmented reality and mixed reality, sometimes referred to as 'extended reality' or XR (Goode, 2019).

Extended reality (XR) is a term referring to all real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables (Greenwold, 2003). It may include such representative forms as augmented reality (AR), mixed reality (MR) and virtual reality (VR), and even the unnamed areas, which might be interpolated among them (Gownder et al., 2016). XR is a superset which includes the entire spectrum from "the complete real" to "the complete virtual" in the concept of reality–virtuality continuum introduced by P. Milgram. The significant connotation lies here in the extension of human experiences, especially relating to the senses of existence (represented by VR) and the acquisition of cognition (represented by AR).

Therefore, XR is a rapid growing field being applied in a wide range of ways, such as extended reality learning, entertainment, marketing, real-estate, training and remote work (Chuah, 2018). Extended Reality Learning (XRL) is XR related term referring to a new immersive experiential learning model that places students into realistic intentional interactions in a virtual metaverse (Goode, 2019).

Augmented reality is a digital overlay into the users real-world environment. AR is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information, sometimes across multiple sensory modalities, including visual, auditory, haptic, somatosensory and olfactory (Schueffel, 2017: 2). Thus, immersive effect may be reached by a combination of surrounding sensory feelings, enhanced with a 360 omnidirectional view. AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects (Wu et al., 2013: 42).

Mixed reality (MR) is the merging of real and virtual worlds to produce new environments and visualizations, where physical and digital objects co-exist and interact in real time. Mixed reality does not exclusively take place in either the physical world or virtual world, but is a hybrid of augmented reality and virtual reality. To mark the difference: Augmented Reality takes place in the physical world, with information or objects added virtually like an overlay; Virtual Reality immerses you in a fully virtual world without the intervention of the physical world (Milgram & Kishino, 1994).

When we talk about the *applicability* of these types of reality (AR, VR, MR, and in the future – about immersive technologies) *in education*, we assume their effectiveness also when used in the study of such disciplines as criminalistics, forensic sciences, criminology, victimology, penitentiary law, etc. Undoubtedly, immersive technologies can contribute to the development of interdisciplinary studies such as cultural criminology.

Cultural criminology analyzes crime and its causes within the context of culture. A number of researchers believe that delinquencies may often be inscribed in a cultural framework (Ferrell, 1999 ; Hayward & Young, 2004). Rather interesting is an attempt of looking at crime as an assemblage (Crockett Thomas, 2020). One of researchers adds that cultural criminology has three tropes: "village", "city street", and "media", in which people influenced by society's views on what is broadcast and accepted as right or wrong. In criminology, among methodological questions arisen (Kane, 2004: 306) was: *how do we transform criminal narrative* (e.g. criminals' personal characteristics, sociocultural and ethnographical background of delinquency, gender aspects) *into data*? XR technologies may also be applicable within this realm of criminological studies.

In the same manner we can talk about innovative forms of teaching the course of criminalistics (forensic science) at the university. In addition to the theoretical part, extremely important in this applied discipline is the practical aspect. To develop practical skills in the work of a forensic specialist, it should be used training facilities, simulators, and various specific techniques. The forensic testing ground (i.e. the criminalistics polygon) helps to implement a practical approach to learning.

The criminalistics polygon serves as a place for experiential training sessions and for practicing exercises. In most cases, it represents a physical model, which imitates the most typical crime scenes. But in recent years, it has been developing the practice of creating not physical models of criminalistics polygons but their virtual analogues.

The criminalistics polygon must be of considerable size in order to work out the implementation of simulated situations in conditions close to reality. The forensic testing ground is defined as a training complex designed for experiments and practical exercises in detecting, withdrawal, fixing and examining evidence. The objects placed at the forensic testing ground (criminalistics polygon) allow simulating the environment for conducting various investigative actions: inspection, investigative experiment, search, and teaching the evaluation of traces of a crime in the complex.

The criminalistics polygon can be created indoors or outdoors. The environment of the forensic testing ground (polygon) can be stationary or changeable (sliding partitions, interchangeable sets of items, mannequins, furniture, cash registers, shelving, consumer goods, computers, imitation drugs, weapons). Among the most typical interiors: shop floor, living room, office, warehouse, city street, bar, garage, vehicle, etc. It could be also police infrastructure: an office of forensic equipment for working with traces, an investigator's office for conducting game interrogation, a confrontation room, and other installations. In addition, binding to regional criminogenic specifics can be implemented. It means that the arrangement of forensic testing grounds (criminalistics polygons) are guided by the statistics of the most typical criminal cases for the given region.

In connection with the development of modern information technologies in the teaching of criminalistics, the term "polygon" has acquired another one content. It is also understood as information databanks and computer programs that helps students to search for information, formulate plots of crimes (i.e. fabula), fill out documents, and train the skills referring to indicative part of investigative actions (examination of the scene, putting forward investigative leads and versions in relation to the subject of the crime, planning and

organizing of investigative and operational activities taking into account the likely portrait of the criminal), and so on.

Virtual polygons have certain obvious advantages: they are compact, allow multiple users to access the program at once, and students do not need to be delivered to the place. However, physical imitation of a real situation has its advantages over computer programs, as it allows students to become participants in events themselves. The educational tasks that are solved at the forensic training grounds are diverse, for example: inspection of the scene (on the street, indoors); study of the traces left by the criminal; collecting evidence; development of the detention of suspects in the commission of a crime. Due to the fact that the teacher should be able to evaluate the practical activities of students at the training ground, its space should be visible. The criminalistics polygon design can be varied. It may consist of several blocks, and access to visual observation of students' activities can be carried out both on the spot and at a remote distance (from a hill, ladders, viewing platforms).

When using forensic testing grounds, we can talk about combining traditional and interactive teaching methods relevant to criminalistics content: discussion of the performed practical actions to investigate and solve crimes, to consolidate practical skills in fingerprinting (forensic dactyloscopy); studying impression evidence (such as fingerprints, footwear impressions, and tire tracks), controlled substances, ballistics, firearm and toolmark examination, and other evidence in criminal investigations; taking plaster casts; using case method, situational approach to solving a learning problem, competitive performance of practical tasks with their further discussion, including the video footage taken during the lesson.

What are the main difficulties on the way of introduction various levels of virtuality (they range from partially sensory inputs to immersive virtuality)?

One of them is financial. Another one (but not so obvious) is mental. As the fundamentals of the social practices have been based on the human physical foundations over the years. Previously, the principles of any action were defined considering physical entities, but nowadays XR creates a paradigm shift in the way we see the world, and how it might be "coded" to augment an existing (so called consensus or consensual) reality.

Though "the metaverse" is the virtual construct, so important for technology driven world, sometimes it may cause a conflict to the real world. Because a lot of the current socioeconomic principles yet does not go aligned with this augmented world. That is why some people do not deny that VR, AR, XR, immersive technologies – all these certainly are amazing and powerful, but (sadly) for large masses of humanity it will mostly be another addiction, – they fear. So, we have to evaluate possible health hazards and to determine safety measures when introducing these technologies into educational process.

Conclusions

Extended reality, VR and AR, immersive technologies, other forms of digital diversification for educational process will have a significant innovative meaning and unique experiential role. In particular, these technologies will demonstrate a transformative potential for such fields as criminology and criminalistics.

As an illustrative example of digital diversification in the mentioned educational areas, we have explored the possibility of using a *virtual criminalistics polygon* in parallel with a conventional physical one, with the ability to shift priority in favor of augmented reality technologies in the nearest future. The benefits of implementing virtual forensic polygons are (at least) the following:

- the cost of maintaining virtual analogues and supporting their functioning is much lower compared to physical models (there's no need to pay so much for land allocation, for rent, for security, for maintaining educational infrastructure on the polygon territory, other services, insurance – all those expenses that are usually borne by the owners or operators of physical objects, land and buildings);

- students do not need to waste their time to reach the place (because, as a rule, the forensic testing grounds, criminalistics polygons are not situated at the university territory; mostly, they're located in another part of the city);

- the ability of using a virtual polygon model to provide practical classes, online training much more often than making visits to a real training ground;

- unlimited possibilities for modeling, changing, improving, expanding virtual models of forensic polygons (diversifying the view of the simulated spaces, changing the conditional scene of the incident, varying circumstances, features, tools and means of committing a crime).

Possible disadvantages include:

- a decrease in real live communication between fellow students, comparatively as if they were transported to the physical place of criminalistics polygon for training in a group.

However, this disadvantage can be compensated quite simply:

- in the process of training, with the creation of a proper VR, AR, MR infrastructure, it will be possible to attract more and more participants at the same time, which enhances the interaction and communication skills;

- it is always possible to combine the use of a real physical model of a forensic polygon, and its virtual analogues, for the purposes of training.

At the same time, it is obvious that with the development of virtual reality technologies,

augmented reality, and especially the wider use of immersive technologies in the equipment of forensic training grounds, we will behold a growing digital diversification and popularity of pure virtual analogues, and spaces where the concepts of augmented reality are implemented. It is precisely because of the advantages mentioned above.

As pictures are worth a thousand words, immersive mediums like VR and AR can be worth a thousand pictures and videos, and that exponential power is one of the reasons why we should to invest our resources and efforts in the project of modernization of "ONMU criminological & criminalistics laboratory". In the long run, it will be more cost-effective for University and stakeholders, and enhance students' practical skills.

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