Strategy for Implementing Immersive Technologies in the Professional Training Process of Future Designers

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Abstract. The article is devoted to the formulation of a strategy for studying immersive technologies in the professional training process of future designers. To formulate the strategy, we reviewed current research in the field of design education on the use of augmented or virtual reality. Based on the analysis of scientific and methodological literature, the features of implementing the study of immersive technologies in the process of professional training of designers are described. There were reviewed educational programs of leading Ukrainian and foreign higher educational institutions in the specialty “design” using SWOT analysis. The strategy for studying augmented reality technology is formulated on the example of the educational program "Graphic Design". Based on the results of the study, it is concluded that immersive technologies can be successfully implemented in higher education institutions with a developed infrastructure, qualified personnel and students with sufficiently developed multimedia competence. The future prospects of the study are connected with the conduction of an experimental study in order to find out the effectiveness of applying the proposed strategy for the implementation of immersive technologies on the example of the educational program "Graphic Design".

1. Introduction

In modern digitalized society, there is a rapid development of "X-realities" (XR), or environments with an additional presence effect, as a result of which there is a rush around contemporary technologies of Virtual (Virtual Reality, VR), Augmented Reality (AR) and Mixed Reality (Mixed Reality, MR). These are powerful technologies that allow us to replace real life with the perception of virtual life, artificially stimulating our senses and deceiving our body into accepting a different version of reality[1]. Augmented reality is a technology that creates the illusion of interaction of digital 3D components with the physical environment (while creating the feeling that three-dimensional objects actually exist). While virtual reality refers to the process of creating a fully digital world that the user can immerse themselves in, the difference between augmented reality technologies is that they combine the real world with virtual artifacts, objects or data. Although augmented and virtual reality are often grouped together because of their obvious similarities, augmented reality tends to place more emphasis on improving existing environments rather than immersing the user in completely new ones. Virtual reality technology best suits in using video games and designing applications for various gadgets. It has recently become widely used in the design of printed products, advertising, motion graphics, and the like. In view of this, it can be argued that the awareness of future designers with XR technologies will significantly increase their competitiveness in the labor market, which indicates the relevance of implementing the study of immersive technologies in the professional training process of designers.
Analysis of research on this problem shows that many scientists have paid attention to the problem of studying the processes of applying immersive technologies in the educational process, for example, a review of the use of VR in STEM education[2] and MR[3]. Scientists paid considerable attention to the problems of teaching game design with VR[4], [5] as well as interface development[6]. There are also studies on the problems of studying immersive technologies by future designers. A large number of studies have been devoted to the integration of immersive technologies into engineering graphics (CAD and 3D) in the training of designers: for example, a study by scientists from Poznań University of Technology[7], which was devoted to the problem of VR in Eco-Design, in the research of scientists from the University of Novi Sad та University of Banja Luka[7], Stevens Institute of Technology[8] and Guangdong University of Technology[9]. There are also studies on the use of AR and VR in the educational process of future designers-architects[10] and environmental designers[11]. The problems of ethical perception by designers of AR and VR product development were outlined by scientists from the College of Directed Studies[12]. In particular, some studies have paid attention to the applied aspects of using immersive technologies in the design process[13], [14]. Special attention should be paid to the study “Augmented Reality Authoring: Generic Context from Programmer to Designer” by scientists from the Technology University of Nottingham [15], which quite widely covers the problems and interaction of designers and programmers in the process of working with AR technologies. That is a study that was devoted to internal and external barriers of immersive technologies in design practice[16] and a publication that is devoted to the application of Virtual-Augmented Reality on Some Design Careers (Product, Multimedia, Graphic)[17]. Given the significant number of scientific publications that deal with various aspects of immersive technologies, it is possible to note the lack of development of the problem of implementing the study of immersive technologies in the process of professional training of future designers in general and graphic designers in particular.

The prospects for the development of augmented reality technologies as a popular niche in the labor market are also indicated by the retrospective forecast for 2020-2025 worldwide in Figure 1, which is given in the Goldman Sachs report[18] on the growth of the immersive technology market in various segments.

![Figure 1. Projected size of global augmented and VR market segments 2020-2025 (in billions $)](image)

Thus, forecasts and a retrospective analysis of the current development of Science and technology indicate that by 2025, the demand for immersive technologies will actively increase, and, which will accordingly grow the revenue from their development.

2. Methodology

In order to introduce the study of immersive technologies by future designers, we investigated the world experience and the potential for implementing immersive technologies. We present the results of a content analysis of the available information on the official resources of higher educational institutions in the form of Table 1.
### Table 1. Comparative characteristics of educational programs with the disciplines of studying immersive technologies

| Institution of higher education | Theme of the educational program | Immersive technologies |
|---------------------------------|----------------------------------|------------------------|
| Dundalk Institute of Technology | Augmented and Virtual Reality     | ● ● ○                   |
| Karnavati University            | Design Interaction Design        | ● ○ -                   |
| Kingston University             | Digital Media Technology         | ○ ○ -                   |
| Kharkiv State Academy of Design & Arts | Multimedia Design | ○ ○ -                   |
| London South Bank University    | Media Production                 | ● ○ ○ -                 |
| Namseoul University             | Virtual Reality and Augmented Reality Studies | ● ● ○ -               |
| NC State University             | Graphic design, industrial design | ● ● ●                   |
| New York Institute of Technology | UX/UI design and development     | ○ ○ -                   |
| Nottingham Trent University    | Games Art                        | ○ ○ -                   |
| Presidency University           | Augmented reality / Virtual reality | ● ● ●                   |
| Ravensbourne                    | Gaming and graphics              | ● - -                   |
| SAE Institute                   | Games Design                     | ○ ● -                   |
| Solent University               | Virtual and Augmented Reality (Design) | ● ○ ○ ○               |
| Shenandoah University           | Virtual Reality Design           | ○ ○ -                   |
| Swinburne University of Technology | Design, Multimedia Design        | ● ○ -                   |
| The Asia Pacific University of Technology & Innovation | Multimedia technology with a specialism in VR/AR | ● ● ●                   |
| The University of Adelaide      | Immersive media - virtual reality | ● ● ●                   |
| Universitat Politècnica de Catalunya | Computer Graphics and Virtual Reality | ● ○ ○                   |
| University of East Anglia       | Computer Graphics, Imaging and Multimedia | ● ○ ○ ○ ○               |
| University of Information Technology and Management in Rzeszow | Graphic Design | ○ ○ ○ -                  |
| University of Plymouth          | Game Arts and Design             | ○ ○ -                   |
| University of the West of Scotland | New Media Art                | ○ ○ -                   |
| University of Winchester        | Digital Media Development: 3D Environments (Game and Heritage) | ● ● -                   |
| Zaporizhzhia National University | Digital Media Technology         | ○ ○ -                   |

We analyzed the specifics and main focus of training programs and the content of disciplines devoted to the study of VR, AR and MR technologies and summarized information on the scope of study (as a
As a separate discipline (Core modules) is indicated, as a separate discipline (Optional) is indicated). According to the results of the study, it was revealed that the vast majority of educational programs do not include immersive technologies as a separate discipline, but implement individual topics in professional disciplines or have separate disciplines of students' choice. Among the disciplines and special modules for studying immersive technologies in the universities under study, the most common are: Introduction to VR/AR, Principals of Augmented Reality Design, Multimedia Applications, Simulation, Visualization and Virtual Reality, user experience of Virtual, Augmented, and Mixed Reality (VR, AR, MR) technologies, Interaction Design, Extended Reality, Trans-media, Multi-media, 3D Modeling for Objects and Environments, Digital Arts and Technology.

For example, French universities actively contribute to the development of the VR industry, improving the quality of educational programs and strengthening the research traditions of this industry, forming professionals and highly qualified VR developers. The direction of development of Mixed Reality technologies is actively implemented in the educational process of a significant number of universities in the UK, carrying out the educational process in specialized VR/AR laboratories (King’s College, MMU and UCL) or in the so-called Realities Center. Greece pays considerable attention to VR research, having formed a base at several universities and research institutes, most of which are located in Athens. Universities in the Netherlands have strong networks of cooperation with companies, and form a large number of highly qualified employees in this field. In Ukraine, there is no program of state support for research in the field of immersive technologies and their implementation in the educational process. VR/AR laboratories are created on the initiative of specialized departments of educational programs in the fields of Information Technology, Computer, Pedagogical Sciences, design with the support of international grant projects, community funds or private investment. Universities in Kiev, Kharkiv, and Lviv are becoming Research Centers for immersive technologies, and a virtual and augmented reality training and Research Laboratory has been opened at Sumy State University. ParisTech University of France conducted 25 years of research on the use of VR in industry. Research on Immersive Technologies is actively carried out by Swedish companies in close cooperation with businesses (University of Stockholm and Stockholm School of Entrepreneurship). The Swiss Commission for Technologies and Innovation (CTI) promotes knowledge transfer and exchange of experience with Swiss universities, supports joint projects, and supports research at the commercialization phase[19].

At the next stage, a SWOT analysis was carried out, the results of which made it possible to determine the hierarchy and positioning of opportunities and threats for implementing the study of immersive technologies in the process of professional training of future designers in the appropriate matrices. The purpose of SWOT analysis is to identify, based on the study of current scientific pedagogical literature and the experience of educational organizations, strengths and weaknesses, opportunities and threats characteristic of the implementation of immersive technologies in the process of professional training of future designers[20]. In the course of the study, we used recommendations on the methodology of SWOT analysis in the educational environment of higher educational institutions, which are described in studies[21]–[24]. The definition of strengths and weaknesses, opportunities and threats was formulated according to the analyzed programs of leading educational institutions (Table 1), according to research materials[15]–[17], our own professional experience in the industry and in accordance with modern labor market realities (Table 2).

| Strengths (S) | Weaknesses (W) |
|--------------|----------------|
| S1. Increasing the level of motivation and productivity of students' learning activities by focusing developments on the modernity, attractiveness and image of immersive technologies | W1. Loss of student motivation because of the complexity and large amount of time spent on the product development process with immersive technologies |
| S2. High price tag of remuneration for a project with immersive technologies, as a result there is a small | W2. Niche development of immersive technologies |

Table 2. detailing the sequence of the process of studying immersive technologies by future designers
In accordance with certain strengths and weaknesses, opportunities and threats, we will build strategies for implementing immersive technologies in the process of professional training of future designers with a main focus on strengths and leveling weaknesses, with an assessment of opportunities and consideration of threats.

### Table 3. Matrix of SWOT analysis strategies

| Type of strategy | Problem code | SWOT strategies (strategic alternatives) |
|------------------|--------------|-----------------------------------------|
| **SO-strategy**  | S1, S2, S3 – O1, O3 | Formulation of an offer of educational services for the formation of popular skills of future designers in accordance with international educational programs to strengthen professional development as a future specialist |
|                  | S4 – O2      | Increasing the position of universities in international rankings through strengthening the research potential of research and teaching staff and forming an internationalization model of higher education institutions based on new competitive advantages in a promising area of study |
| **ST-strategy**  | S1, S2, S3 – T1 | Instilling skills in independent search and innovation activities of future designers to raise awareness of product development using immersive technologies to increase professional positions in the labor market. Promoting international student mobility to raise awareness. |
|                  | S4 – T1      | Involvement of stakeholders in exercises and research of immersive technologies to provide a high level of presentation of educational material |
|                  | S4 – T2      | Promotion of international mobility of research and teaching staff of the university to acquire the required skills of teaching immersive technologies |
| **WO-strategy**  | W1, O1, O3   | Strengthening the motivation of future designers by demonstrating the possibilities of professional development by developing projects with immersive technologies. Introduction of new forms of effective teaching of material for successful
Type of strategy | Problem code | SWOT strategies (strategic alternatives)
--- | --- | ---
W2 – O1, O2, O3 | Assimilation of information (for example, using the case method, gamification of learning, etc) | Formation of future designers’ own initiative project activities at the startup level. Increasing of monetization and salary levels through professional mobility to expand the geography of the labor market and increase the number of offers
W3 – O2 | The possibility of using the material and technical support of higher educational institutions that act as partners in academic mobility. Applying the byod (bring your own device) approach | Restoring the balance of higher education applicants between the need to further improve their technical skills and the need to continue developing their visual thinking in order not just to work out forms with an established set of qualities, but to generate perfect forms that will resonate with new conceptual meanings.

WT-strategy | W1, W2, W3 – T1, T2 | Increasing the interest of research and teaching staff and future designers in expanding the range of skills in the field of immersive technologies through motivation on the example of successful cases, through the exchange of experience by international institutions of higher education.
W1 – T1, T3 | | Restoring the balance of higher education applicants between the need to further improve their technical skills and the need to continue developing their visual thinking in order not just to work out forms with an established set of qualities, but to generate perfect forms that will resonate with new conceptual meanings.

The strategic alternatives proposed on the basis of the SWOT analysis matrix allow us to form a general strategy for implementing immersive technologies in the process of professional training of future designers and determine specific steps for its implementation.

3. Result and Discussion
Having analyzed the available information in the scientific literature, the educational programs and content of disciplines on the study of immersive technologies in the professional training of future designers in various institutions of higher education, we determined an appropriate strategy for building educational material (Figure 2).

In order for the most productive assimilation of educational information by future designers on the development of projects with immersive technologies and in order to form an idea of the application of acquired knowledge in future professional activities, the educational material was introduced into the educational process by separate topics in the disciplines (both Core and Optional).

**Figure 2.** Detailing the sequence of the process of studying immersive technologies by future designers on the example of the educational program "Graphic Design"
4. Conclusion

Augmented and virtual reality technologies as a means of innovative communications in the commercial and public sphere have already established themselves as the most promising at this stage of their development and implementation, and will be actively developed in the near future. The general trend of the virtual and augmented reality market as innovative communication tools has led to the development of vacant labor market offers and competitive salary offers as one of the highest-paid industries. This, in turn, led to the reorganization of the training content of future designers as specialists with professional visualization skills. Increasing profits when using these technologies, attracting maximum attention, novelty in use, prospects and opportunities in the design of advertising, printing publications and marketing - this is only a part of all possible positive effects from the use of augmented and virtual reality in the professional activities of future designers.

Taking into account the above, it is promising and relevant to study the practical principles of implementing the study of immersive technologies in the process of professional training of future designers and research the effectiveness of their implementation. Further research also requires the selection of educational process management tools that will allow us to coordinate strategic goals and monitor the implementation of the overall strategy.

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