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INTERACTIVE PLATFORM "VIRTUAL INVESTIGATIVE CASE" IN THE FORMATION OF PROFESSIONAL COMPETENCIES OF FUTURE LAW ENFORCEMENT OFFICERS

Abstract. This article addresses the problem of modernizing the professional training of future police officers amid the rapid digital transformation of the law enforcement sector and the implementation of the Development Strategy of the Ministry of Internal Affairs system for 2026–2030. The study substantiates the urgent need to bridge the "digital gap" between theoretical training at higher education institutions with specific learning conditions and the actual operational demands of practical units. This gap arises from the insufficient development of specialized digital educational content and security restrictions on cadets' access to active law enforcement information and communication systems. The aim of this study is the theoretical substantiation and experimental verification of the effectiveness of implementing innovative digital content – the interactive platform "Virtual Investigative Case". The authors validate an anticipatory (proactive) model of police training. The methodological basis of the research is an integrated approach, combining a theoretical module, a practical simulator, and OSINT tools within a single web-based environment. The paper comprehensively details the structure of the developed platform, which includes an interactive legal support module, a simulator for practicing response algorithms to missing person reports, and a systematized catalog of verified resources for open-source information search and analysis. Special attention is given to the integration of artificial intelligence elements (chatbots) for modeling real-time verbal communication scenarios with applicants reporting a missing person. Based on the results of a pedagogical experiment conducted at the Donetsk State University of Internal Affairs, the high effectiveness of the proposed methodology has been proven. Comparative analysis demonstrated a statistically significant increase in the proportion of cadets with a high level of digital competence in the experimental group (from 15.0% to 42.0%). The study concludes that utilizing specialized educational prototypes is an indispensable strategy for ensuring the personnel readiness of the National Police of Ukraine to meet the challenges of the digital era.

Keywords: digital competence; future police officers; interactive platform; OSINT tools; simulation training; scenario-based learning.

1. INTRODUCTION

The problem statement. The current stage of reforming the security and defense sector of Ukraine is characterized by systemic and active digitalization of managerial and procedural processes. According to the Development Strategy of the National Police of Ukraine for 2026–2030 [1], the implementation of the latest information and communication systems, specifically the "Electronic Investigative Case" subsystem of the Information Portal of the National Police of Ukraine (NPU) [2], is defined as a priority task. However, the rapid pace of technological

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change outstrips the adaptive capabilities of the educational environment in higher education institutions (HEIs) with specific learning conditions.

Today, there is an acute contradiction between the objective need to train specialists capable of working fluently in the conditions of active digitalization of society in general, and the law enforcement sector in particular, and the impossibility of providing cadets with access to real working databases in classrooms due to security restrictions and requirements for the protection of state secrets [3]. This creates a "digital gap" between the acquired theoretical knowledge of learners at HEIs with specific learning conditions of the Ministry of Internal Affairs (MIA) system and the real requirements for the digital competence of law enforcement officers.

Addressing this problem requires the development and implementation of innovative specialized digital content for educational institutions of the MIA system, which would serve as a safe educational simulator of professional activity. The innovativeness of the proposed approach lies in the implementation of an anticipatory (proactive) learning model through the interactive platform "Virtual Investigative Case" [4]. This project represents a unique scientific and methodological innovation in departmental education, as it offers the first educational prototype of the future official system "Electronic Investigative Case" of the Information Portal of the National Police of Ukraine. This allows cadets to master the logic and principles of digital workflow in investigative activities even before the start of actual service.

This project holds social significance, as enhancing the level of training for law enforcement officers directly impacts the effectiveness of searching for missing persons, particularly children, which is critically important under the current conditions of martial law. The project creates a unified digital ecosystem where theoretical knowledge is integrated with practical simulators and OSINT (Open Source Intelligence) tools, ensuring deep assimilation of material regarding investigative work. The implementation of such developments ensures the formation of a high-quality personnel reserve capable of immediate adaptation to the digital transformation of state bodies, making a significant contribution to the development of practice-oriented education and the strengthening of the state’s personnel potential.

Analysis of recent studies and publications. The issue of education digitalization and the implementation of innovative content in the professional training of modern specialists is at the center of attention of many domestic and foreign researchers. To establish a basic background for our highly specialized research, it is essential to analyze the fundamental theoretical and methodological principles of general education informatization. Specifically, ontological approaches to developing users' digital skills [5], alongside comprehensive strategies for integrating generative artificial intelligence into the modern educational space [6], [7], [10], establish a broader pedagogical framework. Furthermore, prior empirical experiences in deploying virtual laboratory systems and specialized analytical software to ensure the professional orientation of student training [8], [9] provide essential didactic foundations. While these studies [5]–[10] comprehensively cover the general digitalization of higher education, they serve as a fundamental baseline that requires specific adaptation to address the unique operational demands and simulated environments inherent in law enforcement training.

Specific issues regarding the development of digital platforms and applications, as well as their implementation in the university educational process, are explored in the works of various foreign researchers [11] – [14]. In their studies, scientists reveal the features of developing innovative digital content and its didactic potential in modern higher education, emphasizing the importance of flexibility and interactivity of educational materials. Concurrently, a systematic review of immersive virtual reality applications in higher education conducted by J. Radianti et al. enables the identification of key design elements and the consideration of existing research gaps in the design of innovative educational environments [15]. Alongside technological aspects, instructional methodology plays a crucial role, as

evidenced by the meta-analysis by M. Sailer and L. Homner [16]. Based on empirical data, they demonstrated the positive impact of gamification on students' cognitive, motivational, and behavioral learning outcomes. In the context of internationalization and global trends in the digitalization of law enforcement, foreign researchers, particularly those studying scenario modeling in Simulation-Based Learning systems, emphasize the critical importance of the authenticity of the educational environment for forming the professional readiness of police officers.

Among domestic achievements in developing innovative digital content for the professional training of future law enforcement officers in HEIs with specific learning conditions of the MIA system, we highlight the "Barnahus" model by M. Popovych [17] regarding children's rights during criminal investigations; innovative educational technologies in police firearms training classes [18]; the introduction of simulation training, case methods, situational tasks, and trainers using AI [19], etc. Important foreign achievements in innovative digital content for police professional training include developments in the field of Virtual reality (VR) in law enforcement training [20], VR simulations [21], and the importance of changes in education due to the digital transformation of policing in general [22].

Regarding the latest innovations in the chosen area, the global landscape of law enforcement training is currently experiencing a paradigm shift driven by generative AI, Extended Reality (XR), and advanced data analytics. Important foreign achievements in police professional training actively incorporate Large Language Models (LLMs) for dynamic suspect interrogation modeling, immersive VR simulations for stress-inoculation and de-escalation training [20], [21], and automated OSINT aggregators for digital forensics [22]. However, despite these global technological leaps and a significant number of works on the general informatization of education, there remains a critical gap in domestic departmental education. Namely, there is a lack of specialized educational prototypes that synergistically integrate these modern innovations – specifically combining interactive procedural simulators, AI-driven virtual applicants, and OSINT toolkits – into a single, cohesive, and domestically adapted digital environment.

However, despite a significant number of works on the general informatization of education and the development of digital competence, as well as separate studies on the digitalization of education in HEIs with specific learning conditions of the MIA system, there remain previously unresolved parts of the general problem to which this article is dedicated. Namely, the lack of specialized educational prototypes and simulators that would help improve the acquired theoretical knowledge of future law enforcement officers in investigative work, which creates a gap between training and practice. Furthermore, there is insufficient integration of OSINT tools, which involves combining classical investigative methods with modern tools for open-source analysis (web intelligence) within a single digital educational content.

It was the need to resolve these contradictions that led to the development of the interactive platform "Virtual Investigative Case" [4] and the study of its impact on the training of future police officers.

The scientific novelty of the research lies in the theoretical substantiation and practical implementation of an anticipatory (proactive) learning model in law enforcement education. Unlike traditional didactic models, which predominantly rely on retrospective paper-based case studies or isolated static e-learning modules, the proposed proactive model immerses learners in a dynamic digital ecosystem that mimics the functionality of the forthcoming official "Electronic Investigative Case" system. This distinctively prepares cadets for IT systems that are currently being implemented in practice, significantly reducing their future professional adaptation period.

Furthermore, the novelty is defined by the unique architectural integration of three disparate components within a single educational web environment: 1) an interactive legal

framework, 2) a procedural simulator with OSINT toolkits, and 3) AI-driven virtual personas. While foreign studies have explored immersive technologies and AI in police training, the specific application of customizable AI chatbots to simulate real-time distressed verbal communication and psychological profiling of applicants in missing persons cases represents a pioneering methodological approach in domestic departmental education.

The aim of the study is the theoretical substantiation and experimental verification of the effectiveness of implementing the interactive platform "Virtual Investigative Case" as innovative digital content for forming the professional competencies of future law enforcement officers in higher education institutions with specific learning conditions.

2. RESEARCH METHODS

To achieve the set goal, a complex of scientific research methods was utilized. Among the theoretical methods, the analysis of scientific literature was employed, namely, the study of psycho-pedagogical, methodological, and professional sources regarding the problem of informatization of the educational process in higher education institutions, as well as the development and use of specialized software. Additionally, an analysis of the relevant regulatory framework was conducted, including the study of educational standards, the Development Strategy of the National Police of Ukraine for 2026–2030, educational and professional training programs for learners in HEIs with specific learning conditions [23].

Among the empirical methods, pedagogical observation and testing were used to diagnose the level of cadets' digital competence formation while working with professional digital content, specifically the interactive platform "Virtual Investigative Case" [4]. While the formative stage of the pedagogical experiment was conducted over a two-month period (September – October 2025), this timeframe corresponded to the highly intensive, concentrated study module of the specialized operational and search disciplines (such as "Operational and Search Activity", "Investigative Work of Criminal Police Units", "Covert Investigative (Search) Actions", and "Disclosure of Specific Types of Crimes"). This period was sufficient for an initial pilot validation of the platform's immediate impact on specific procedural skill acquisition, although long-term competency monitoring is planned for future longitudinal studies.

To implement the expert assessment method, a formalised evaluation was conducted involving practitioners from criminal police units. The experts assessed the platform using a standardized evaluation matrix based on three clear criteria: 1) professional authenticity of the simulated investigative scenarios; 2) strict compliance of the digital algorithms with the current Criminal Procedure Code of Ukraine; and 3) the practical usability of the interface for educational purposes. The expert panel, which included the Head of the Main Directorate of the National Police in the Zaporizhzhia region, General of Police of the Third Rank, PhD in Law, Associate Professor A. Kysko, and the Head of the Criminal Police of the Main Directorate of the National Police in the Kirovohrad region, Lieutenant Colonel of Police V. Chernykh, rated the platform highly across all criteria. Both heads formally noted the practical orientation of the project and its importance for training future specialists in the context of the police digital transformation.

To ensure the statistical homogeneity of the groups prior to the experiment, a stratified sampling method based on the cadets' preliminary academic performance (initial pre-test results) was applied rather than a simple random sampling. This approach guaranteed an approximately equal distribution of initial knowledge levels between the Control and Experimental groups.

The effectiveness of using the platform was evaluated according to three main criteria: cognitive criterion (the level of theoretical knowledge regarding investigative activity

algorithms and regulatory support); activity-practical criterion (the ability to correctly process applications, form an electronic profile of a missing person, and compile official documentation in a digital environment); analytical criterion (the level of proficiency in OSINT tools for collecting and verifying information from open sources during investigative measures in the digital space).

To measure these criteria, specific diagnostic tools were developed and applied. The cognitive criterion was assessed using a computer-based theoretical test consisting of 30 targeted questions. The activity-practical criterion was evaluated through a practical scenario-based task within the simulator, where the system automatically recorded errors and the time taken to draft an electronic profile. The analytical criterion was measured via a timed OSINT search task evaluating the accuracy of the gathered digital footprint data. Based on the cumulative results across these diagnostic tools, the cadets were classified into three levels of digital competence formation: High (90 – 100 points, demonstrating flawless execution and deep understanding), Medium (74 – 89 points, showing minor procedural errors but overall competency), and Low (below 74 points, indicating an inability to complete the digital investigative tasks without significant instructor assistance).

3. THE RESULTS AND DISCUSSION

3.1. Conceptual Principles of Designing Innovative Digital Content.

The core theoretical construct of this research is the anticipatory (proactive) learning model. In the context of law enforcement education, this model represents a forward-looking pedagogical framework that shifts the focus from traditional retrospective case analysis to proactive preparation for emerging technological realities. The essence of this model lies in creating didactic conditions under which learners acquire investigative skills and master the logic of new information subsystems even before their full-scale commissioning in the practical units of the National Police of Ukraine.

Based on this theoretical foundation, the architecture of the digital educational environment – the interactive platform "Virtual Investigative Case" (hereinafter – VIC) – was developed by the team of authors (A. Voloboiev, O. Lunhol, O. Haborets, S. Pekarskyi, and S. Zelenskyi) [4]. The implementation of this platform is necessitated by the acute contradiction between the growing requirements for the digital competence of police officers and the limited capabilities of higher education institutions regarding access to real operational databases. This proactive approach allows bridging the "digital gap" and significantly reducing the graduate's adaptation period at the workplace, as the specialized operational and search disciplines, for which the platform was developed, are taught to final-year undergraduate students of the first (Bachelor's) level of higher education [23].

The methodological basis for developing the interactive platform "Virtual Investigative Case" was an integrated approach, which involves combining a theoretical basis, practical training in documenting investigative work, and the use of OSINT tools within a single browser window.

The technical implementation of the platform is carried out using cloud technologies, ensuring cross-platform compatibility and the possibility of remote use during blended learning. The web resource is hosted at: https://itinitiativescyber.wixsite.com/virtuall [4].

3.2. Structural and Functional Model of the Interactive Platform "Virtual Investigative Case"

An analysis of the developed digital content's structure allows for the identification of three interrelated functional blocks, each aimed at forming specific groups of professional competencies in future law enforcement officers: "Theoretical Materials", "Simulator", and "OSINT Technologies" (Fig. 1).

The "Theoretical Materials" block constitutes the theoretical and regulatory support of the interactive platform. This component performs a cognitive function and serves as a foundation for subsequent practical work based on the "Simulator" block.

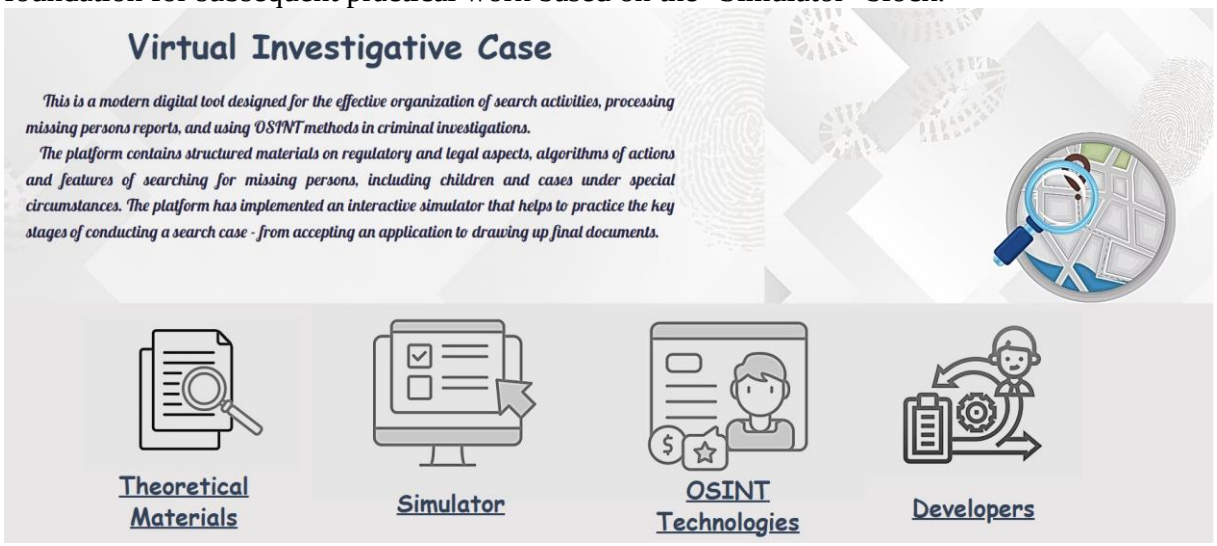

Fig. 1. Main page and structure of the interactive platform "Virtual Investigative Case"

The theoretical block of the interactive platform "Virtual Investigative Case" is structured according to the problem-search principle. It contains an updated database of legal acts regulating investigative activities (with hyperlinks to specific current regulations); algorithms of police officer actions upon receiving a missing person report; specific protocols for searching for minors and persons missing under special circumstances; and procedures for the interaction of criminal police units with other law enforcement services in searching for missing persons.

The innovativeness of this block lies in its integration with the practical simulator: the cadet has the opportunity to refer to a "digital theoretical hint" directly during the task execution on the simulator, which fosters the skill of legally justifying each procedural step.

The key element of the platform, which implements the activity-based approach, is the "Simulator" block. The simulator models the workplace of a criminal investigation officer and allows for reproducing the full cycle of conducting an investigative case in a virtual environment. The main goal of the simulator is to provide learners with the opportunity, in a safe digital environment, to practice processing applications, working with information, creating an electronic profile of a missing person, analyzing and recording the chronology of events, conducting primary analytical data processing, and honing communication skills while interacting with a virtual applicant in real time.

The simulator helps form skills in working with personal data; the ability to fill out investigative documentation in accordance with standards; a practical understanding of the logic of actions following the receipt of a missing person report; and competence in information processing for effective interagency cooperation. Thus, the virtual simulator serves as an innovative tool for specialist training, combining legal, analytical, and digital aspects of professional activity in the field of criminal analysis and investigative work (Fig. 2).

The functionality of the simulator encompasses the following stages:

1. Reception and registration of the report – the cadet works with electronic forms to practice person search skills. The system automatically verifies the accuracy of filling in mandatory fields in accordance with the assigned task.

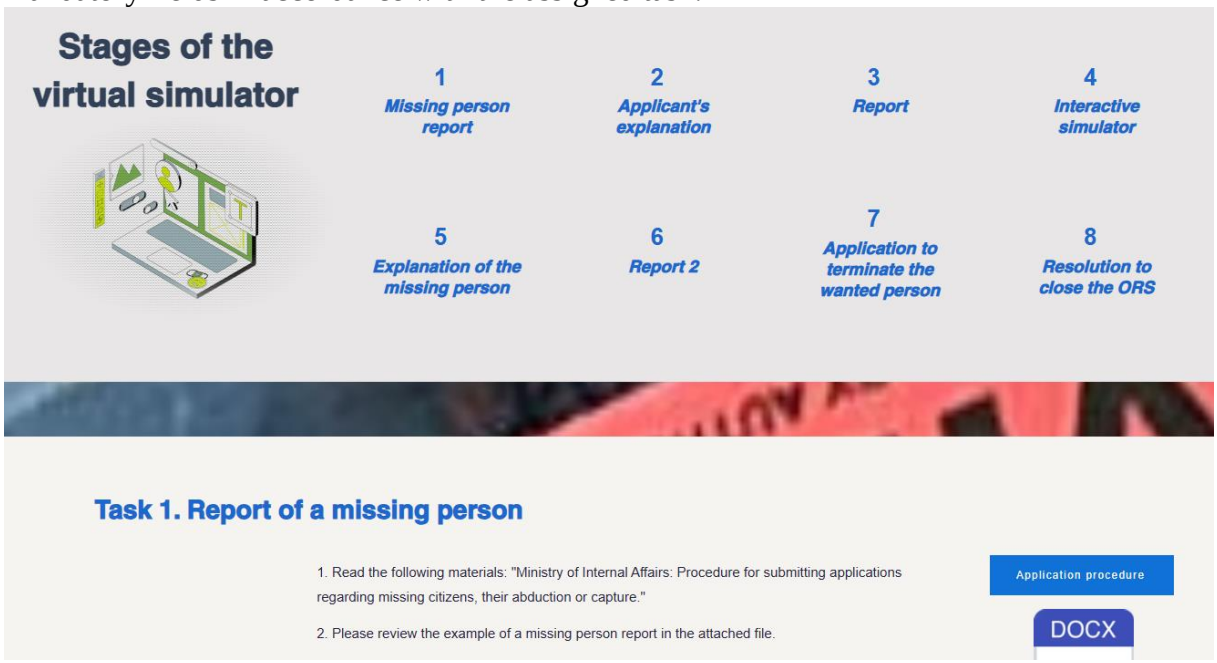

Fig. 2. Functional block "Simulator" of the interactive platform "Virtual Investigative Case"

2. Creation of the “Missing Person Electronic Profile”. At this stage, the learner’s attention to the details of the investigative case (anthropometric data, clothing description, distinguishing marks, etc.) is honed.

3. Planning of search measures, where the interactive module allows selecting the necessary investigative (search) actions from a drop-down list and formulating an investigation plan.

A distinct feature of the simulator is the utilization of AI elements (specifically, a chatbot) to model a dialogue with the applicant. This facilitates the development of communication skills with a virtual applicant and the ability to extract operationally significant information from both direct chat interactions and spoken language during a real-time virtual call using a voice module. The AI-powered interactive trainer "Dialogue with the Applicant", which is a component of the "Simulator" functional block of the interactive platform "Virtual Investigative Case" (Fig. 3), currently includes three applicant personas:

Persona 1. Anna Petrova represents an applicant whose psychological profile is that of an emotional and distraught wife reporting the disappearance of her husband. This persona allows for the training of learners' skills in establishing emotional rapport, exercising patience, and structuring a narrative that is chaotic due to distress. During the interaction, cadets learn to establish psychological contact, listen empathetically, patiently structure the received information, distinguish facts from emotions, and delicately yet persistently clarify the details of the argument and the missing person's last known actions.

Persona 2. (father of a missing teenager) is designed to teach how to build trust and obtain sensitive information that a person might attempt to conceal. The educational goal of interacting with this persona lies in the ability to overcome the applicant's initial resistance, establish trust (even when the person is reluctant to open up), delicately gather complete information about the missing person (especially sensitive details regarding behavior and secondary social circles), identify hidden motives, and build a questioning strategy.

Persona 3. Vadym (friend/the last person to see the missing individual) is created to teach cadets to work with indirect testimony, identify inconsistencies, and apply skills in analyzing non-verbal cues. The educational objective of communicating with this persona is to hone learners' skills in working with witnesses who are not always ready to share full information;

Fig. 3. AI-powered interactive trainer "Dialogue with the Applicant" of the "Simulator" functional block of the interactive platform "Virtual Investigative Case"

detecting hidden motives and contradictions in testimony; using clarifying questions; analyzing non-verbal cues; and formulating tactics for further questioning to obtain the most complete and truthful data.

For each described persona, the developers have prescribed a detailed psychological profile and the specific situation preceding the disappearance of the reported individual. The AI strictly adheres to this psychological profile while following the core of the prescribed scenario. Crucially, the learners do not have access to these psychological profiles or the situational descriptions.

The *character.ai* platform, upon which the three personas of the "Virtual Investigative Case" interactive platform were built, enables learners to independently create and customize personas of applicants or victims. They can create their own bots by defining detailed instructions, including character traits, biography, speech style, knowledge base, goals, etc. This facilitates the modeling of any personality within various contexts: applicants, victims, or individuals missing under diverse circumstances, including conditions of martial law.

From a technological perspective, the interactive AI module leverages Natural Language Processing (NLP) and Large Language Model (LLM) architectures. The specific applicant personas were developed utilizing advanced prompt engineering techniques. The developers configured the system by setting specific behavioral weights, defining context windows, and establishing strict system constraints to prevent AI hallucination and ensure the dialogue remains within the boundaries of the investigative scenario. This technological integration directly enhances the activity-practical competency of the cadets: it transitions the learning environment from passive reading to active, adaptive problem-solving. By interacting with a dynamic NLP algorithm rather than a static script, learners are forced to apply cognitive and psychological tactics in real-time, significantly boosting their professional communication skills.

Unlike basic chatbots, this model retains the conversation context and can simulate emotions, such as empathy or aggression (depending on the configuration). The platform supports role-playing scenarios by textually describing the character's actions. It also offers a group chat feature where multiple AI personas interact simultaneously, while the user moderates or participates in the discussion. Furthermore, the platform allows for voice generation for the character, rendering the dialogue simulation even more realistic.

Considering modern trends in crime investigation, which directly involve information searching in the digital space, an OSINT module has been integrated into the platform's structure (Fig. 4). This block does not merely contain links to resources but offers a systematized methodology for tracing a person's "digital footprint": search tools by email address, username, photo or image, and within social networks; information verification algorithms; and practical cases for honing skills in working with recommended OSINT resources for searching for missing persons.

Fig. 4. Functional block "OSINT Technologies" of the interactive platform "Virtual Investigative Case"

3.3. Methodology of Applying the Interactive Platform in the Educational Process.

The implementation of the interactive platform "Virtual Investigative Case" into the educational process of the Donetsk State University of Internal Affairs was carried out within the framework of teaching the previously mentioned disciplines with an operational and search focus.

To ensure maximum effectiveness in using the platform’s digital content, the authors piloted the scenario-based learning methodology. This methodology is based on the principles of contextual immersion and simulation modeling of professional activity. The training is structured around comprehensive plotlines (cases) – simulated situations that evolve dynamically depending on the learner’s actions.

The algorithm for implementing the methodology, illustrated by the case study *"Missing Minor Search"*, is as follows:

Stage 1. Obtaining Input Information and Primary Communication (Block "Simulator" of the interactive platform "Virtual Investigative Case"). The cadet, acting in the role of a criminal investigation officer, receives a call regarding the disappearance of a child. The module "Task 4. AI-based Interactive Trainer 'Dialogue with the Applicant', Persona 2. Hennadii Petrovych (father of the missing teenager)" is activated, simulating a dialogue with the applicant – the father of the missing teenager. The AI chatbot is configured for emotional behavior (anxiety, confusion about dates), requiring the cadet to apply psychological techniques to calm the citizen and obtain valid data (time of disappearance, physical description, phone number, last contacts, etc.). Furthermore, during this interaction, cadets learn to overcome the applicant's initial resistance, establish trust (even when the person is reluctant to open up), delicately gather complete information about the missing person (especially sensitive details regarding behavior and secondary social circles), identify hidden motives, and build a questioning strategy. Result: The formation of an initial report in the electronic system.

Stage 2. Legal Qualification and Planning (Block "Theoretical Materials" and Block "Simulator").

Before commencing active investigative actions, the cadet must verify the legal grounds for the search. Using the "Theoretical Materials" block, the learner consults the interactive guide to check the relevant articles of the Criminal Procedure Code (CPC) of Ukraine and departmental orders regarding the algorithm of actions in cases of missing children. In the simulator (Block "Simulator"), the cadet opens the "Unified Registration" electronic card and qualifies the event. The system automatically blocks further steps if the qualification is erroneous, providing a hint with a reference to the regulatory acts.

Stage 3. Collection and Analysis of Information from Open Sources (Block "OSINT Technologies"). The learner receives a photograph of the missing person and their mobile phone number from the instructor. The cadet must use the integrated tools (Block "OSINT Technologies") for: image search, including within social networks; digital footprint analysis (examining recent posts, geotags, and friends' comments – for educational purposes, in one of the comments, friends arrange a meeting at a specific cafe); and building a connection graph to establish the social circle.

Stage 4. Procedural Documentation and Decision Making (Block "Theoretical Materials" and Block "Simulator"). Based on the obtained OSINT data, the cadet compiles a "Search Measures Plan" and enters new information (probable location) into the person's electronic profile. The system generates a final report, evaluating not only the fact of finding the person but also the procedural literacy of the compiled documents and the time spent on the search.

The proposed methodology enables the realization of the "learning by doing" principle. A key advantage is the creation of a safe educational space: an error in the virtual environment (e.g., an incorrectly selected search category or a missed element of the digital footprint) becomes a subject of analysis and an element of the learning experience, rather than leading to real negative consequences, as could happen in practical activity. In addition to individual work, the methodology involves debriefing – a group discussion of the case results under the guidance of an instructor, where typical errors and alternative search algorithms are analyzed.

3.4. Results of the Pedagogical Experiment

To verify the effectiveness of implementing the interactive platform "Virtual Investigative Case" into the educational process of a higher education institution with specific learning conditions, a pedagogical experiment was conducted, which encompassed ascertaining and formative stages. The study involved 172 3rd-year cadets of the E.O. Didorenko Education

and Research Institute of Training Specialists for Criminal Police Units at the Donetsk State University of Internal Affairs. Using the stratified sampling method based on preliminary academic performance (as detailed in Section 2), the respondents were distributed into two representative groups:

Control Group (CG) – 90 individuals trained according to the traditional methodology.

Experimental Group (EG) – 82 individuals, into whose educational process the "Virtual Investigative Case" platform was integrated (based on the approbation results, an Act of Implementation into the educational process of the DonSUIA dated October 27, 2025, was obtained for the interactive platform "Virtual Investigative Case").

In the context of this study, the professional digital competence of a future police officer is defined as an integrated system of specialized knowledge, practical skills, and analytical abilities necessary for the legal and secure use of departmental information systems (specifically the "Electronic Investigative Case"), the application of open-source intelligence tools, and effective simulated digital communication during investigative activities. Based on this definition, the diagnosis of the level of formation of professional digital competence in investigative work was conducted based on three criteria: cognitive (knowledge-based) – completeness and systematic nature of knowledge regarding the regulatory framework; activity-practical – the ability to correctly and efficiently work with the system interface and draft procedural documents; analytical (research-based) – the capability to apply OSINT tools to obtain operationally significant information.

At the ascertaining stage, predominantly medium and low levels of proficiency in using digital tools for investigative work were identified in both groups. Statistical verification demonstrated the absence of significant differences between the groups, as the empirical value of the criterion was strictly lower than the critical value:

$$\chi^2_{emp} < \chi^2_{crit} \quad (1)$$

which confirmed their homogeneity before the start of the training.

Upon completion of the formative stage, a repeated diagnostic assessment was conducted. Comparative analysis of the results in the CG and EG demonstrated significant positive dynamics in the experimental group (Table 1).

Table 1

Dynamics of cadets' digital competence formation levels (%)

Levels of formation	**Control Group (CG), n_1=90**		**Experimental Group (EG), n_2=82**	
	Before	*After*	*Before*	*After*
High	14	20	15	42
Medium	46	48	45	40
Low	40	32	40	18
Total	*100*	*100*	*100*	*100*

Analysis of the data in Table 1 indicates that after the completion of training, a qualitative increase in indicators was recorded in the EG: the number of cadets with a high level increased almost threefold — from 15.0% to 42.0%. Meanwhile, in the CG, the increase amounted to only 6% (from 14.0% to 20.0%). Furthermore, the proportion of individuals with a low level decreased significantly in the EG (to 18.0%), whereas in the CG, it remained substantial (32.0%).

To confirm the reliability of the obtained results, Pearson's chi-squared χ^2 test was used. The following hypotheses were formulated: H_0 – the competence levels in the EG and CG after

the experiment do not statistically differ; H_1 – the competence level in the EG is statistically higher than in the CG.

The calculation of the empirical value of the criterion was performed using the formula:

$$\chi^2_{emp} = N \cdot M \cdot \sum_{i=1}^{L} \frac{\left(\frac{n_i}{N} - \frac{m_i}{M}\right)^2}{\nu_i + \mu_i} \quad (2)$$

where $N = 90$ and $M = 82$ are the total sample sizes of the CG and EG, respectively;

L is the number of assessment levels ($L = 3$);

n_i and m_i represent the absolute number of cadets who reached the *i-th* competence level in the CG and EG, respectively.

To facilitate the verification of the statistical results, the intermediate raw data and calculations are presented in Table 2.

Table 2

Intermediate raw data for Pearson's chi-squared χ^2 test calculation (Formative Stage)

Competence Level (*i*)	CG (n_i)	EG (m_i)	Total ($n_i + m_i$)
High (*i=1*)	18	34	52
Medium (*i=2*)	43	33	76
Low (*i=3*)	29	15	44
Total	*N = 90*	*M = 82*	*172*

Based on the calculation results, the empirical value obtained is: $\chi^2_{emp} = 10.34$. The critical value of the criterion for the number of degrees of freedom $\nu = 2$ at a significance level of$\alpha = 0.05$ is $\chi^2_{crit} = 5.991$.

Since $\chi^2_{emp} > \chi^2_{crit}$ (10.34 > 5.991), the null hypothesis H_0 is rejected, and the alternative hypothesis H_1 is accepted. This provides grounds to assert the statistical significance of the obtained results (with a probability of 95%) and confirms that the implementation of the interactive platform "Virtual Investigative Case" significantly influenced the improvement of the quality of specialist training during the teaching of these specialized law enforcement disciplines. The uniqueness of the results lies in confirming the effectiveness of the anticipatory model: cadets who worked with the system prototype demonstrate psychological and practical readiness for investigative work. The empirical data obtained align with the findings of M. Bond et al. [24], who, based on a systematic evidence map, demonstrated that the integration of educational technologies and specialized software significantly enhances student engagement, which is a critical factor for the effective development of professional competencies in a digital environment. The platform's implementation also highlighted the necessity for continuous updating of the OSINT block cases, as search tools become obsolete rapidly, requiring high digital agility from the instructors.

Furthermore, to substantiate the activity-practical criterion regarding the efficiency of documentation processing, a chronometric assessment was conducted under standardized classroom conditions during the final practical modules. The measurement involved all 172 cadets participating in the experiment (90 in the control group and 82 in the experimental group). All participants were provided with identical input data and tasks. The time taken by cadets to process an initial missing person report, compile an electronic profile, and draft a primary search plan was individually recorded by the instructors. The quantitative data showed that cadets in the experimental group, utilizing the automated templates, drop-down lists, and digital hints of the "Virtual Investigative Case" platform, completed these tasks in an average of 27 minutes. In contrast, the control group, using traditional paper-based drafting methods, required an average of 45 minutes. So, the implementation of the digital platform reduced the time required to process investigative documentation by 40%.

While the interactive platform demonstrates high pedagogical efficacy, we acknowledge significant technological limitations associated with its current prototyping stage. The initial version of the platform is hosted on the free Wix website builder. This decision was driven by the necessity for rapid prototyping (creating a Minimum Viable Product) and immediate deployment within the educational process. However, considering the specific and sensitive nature of law enforcement activities, this architecture poses inherent constraints regarding scalability, stability, and information security. For a full-scale integration into the MIA system, this educational prototype must be migrated to a proprietary, secure on-premise server infrastructure, certified in accordance with Ukrainian state standards for comprehensive information protection systems.

Furthermore, the AI simulation module currently relies on Character.ai, a third-party commercial platform. This introduces objective risks of vendor dependence, potential changes to terms of service, availability disruptions, and data privacy concerns regarding transfer to third-party servers. To strictly mitigate these risks during the educational experiment, a rigid data security protocol was enforced: cadets are categorically prohibited from entering real personal data, actual operational details, or state secrets. All training scenarios utilize exclusively synthetic, fictionalized legends.

Finally, we must explicitly acknowledge the limitations regarding the generalization of the study's results. As previously stated, the formative stage of the pedagogical experiment was conducted over a relatively short two-month period. While this intensive timeframe was sufficient to demonstrate a statistically significant immediate improvement in specific operational skills, it limits the ability to draw definitive conclusions about the long-term retention and comprehensive formation of complex digital competence. Therefore, the current findings should be interpreted primarily as evidence of the platform's short-term pedagogical efficacy. To confirm the long-term stability of the acquired competencies, further longitudinal studies over extended academic periods are required.

4. CONCLUSIONS AND PROSPECTS OF FURTHER RESEARCH

This research study substantiates the relevance and importance of developing innovative digital content for the professional training of future law enforcement officers in higher education institutions with specific learning conditions. It is demonstrated that, in the context of the digital transformation of the law enforcement sector and existing security restrictions, the use of specialized educational simulators is an effective way to bridge the "digital gap" between theoretical training in HEIs and the actual practical needs of the National Police of Ukraine. A practical result of this study is the piloting of the interactive platform "Virtual Investigative Case" [4], developed by the team of authors. Its architecture is based on an integrated approach combining theoretical content, a simulator, and OSINT tools for investigative work within a unified web environment. This allows for modeling the full cycle of investigative activity: from receiving a report and communicating with the applicant (via an AI-based chatbot) to analyzing digital footprints and drafting procedural documents.

The pedagogical experiment robustly proved the efficacy of the proposed proactive learning model. Specifically, the statistical verification ($\chi^2_{emp} > \chi^2_{crit}$, $10.34 > 5.991$) confirmed that immersing cadets in a dynamic, AI-driven digital ecosystem significantly outperforms traditional paper-based didactic methods. The study proved that the integration of NLP-based virtual applicant simulations and real-time OSINT toolkits into the educational process directly bridges the gap between theoretical knowledge and practical application. This technological authenticity not only facilitated a near threefold increase (from 15.0% to 42.0%) in the number of cadets demonstrating high-level digital competence, but also demonstrably

optimized their operational efficiency, evidenced by the objectively recorded 40% reduction in documentation processing time.

Thus, the research conclusively proves that the deployment of specialized educational prototypes – which replicate the logic of forthcoming official IT systems – is a critical determinant of professional readiness. It shifts the educational paradigm from passive knowledge acquisition to adaptive, computationally-assisted problem-solving in the digital space.

We envision the further development of the project in: scaling the implementation of the platform into the educational process of other higher education institutions with specific learning conditions within the system of the Ministry of Internal Affairs of Ukraine; increasing the number of AI-based personas to implement real-time verbal communication scenarios with applicants and witnesses; and developing adaptive non-linear scenarios where the investigation plotline automatically changes depending on the tactical decisions made by the cadet at previous stages.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

During the preparation of this manuscript, the authors used Gemini (Google) for the purpose of proofreading, correcting grammatical, spelling, and stylistic errors. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the final content of the publication.

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the preparation, submission, and publication of this article.

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ІНТЕРАКТИВНА ПЛАТФОРМА «ВІРТУАЛЬНА РОЗШУКОВА СПРАВА» У ФОРМУВАННІ ПРОФЕСІЙНИХ КОМПЕТЕНТНОСТЕЙ МАЙБУТНІХ ПРАВООХОРОНЦІВ

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Анотація. У статті актуалізовано проблему модернізації професійної підготовки майбутніх поліцейських в умовах стрімкої цифрової трансформації правоохоронної сфери та реалізації Стратегії розвитку органів системи МВС на 2026-2030 роки. Обґрунтовано нагальну необхідність подолання «цифрового розриву» між теоретичною підготовкою в закладах вищої освіти зі специфічними умовами навчання системи МВС та реальними оперативними потребами практичних підрозділів, що виникає через недостатню розробку спеціалізованого освітнього цифрового контенту та режимні обмеження доступу здобувачів до діючих правоохоронних інформаційно-комунікаційних систем. Метою даної роботи є теоретичне обґрунтування та експериментальна перевірка ефективності впровадження інноваційного цифрового контенту – інтерактивної платформи «Віртуальна розшукова справа». Авторами апробовано випереджальну (проактивну) модель навчання поліцейських. Методологічну основу дослідження складає інтегрований підхід, що передбачає поєднання в єдиному веборієнтованому середовищі теоретичного блоку, практичного симулятора та інструментарію OSINT. У роботі детально розкрито структуру розробленої платформи, яка містить інтерактивний модуль нормативно-правового забезпечення, тренажер для відпрацювання алгоритмів реагування на заяви про зникнення осіб, а також систематизований каталог верифікованих ресурсів для пошуку та аналізу інформації з відкритих джерел. Окрему увагу приділено впровадженню елементів штучного інтелекту (чат-ботів) для моделювання сценаріїв вербальної комунікації із заявниками про зникнення особи в режимі реального часу. За результатами педагогічного експерименту, реалізованого на базі Донецького державного університету внутрішніх справ, доведено високу ефективність запропонованої методики. Порівняльний аналіз засвідчив статистично значуще зростання кількості здобувачів з високим рівнем цифрової компетентності в експериментальній групі (з 15,0% до 42,0%). Зроблено висновок про те, що використання спеціалізованих освітніх прототипів є безальтернативним шляхом забезпечення кадрової готовності Національної поліції України до викликів цифрової епохи.

Ключові слова: цифрова компетентність; майбутні поліцейські; інтерактивна платформа; інструменти OSINT; симуляційне навчання; сценарне навчання.

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