Pedagogical conditions for training future specialists to use aviation profiling in professional activities

Aigul Beisenbayeva[1,*,†], Suleimen Kaimov[2,†], Talgat Kaiym[2,†], Zhansaya Bekaulova[2,†] and Tolganay Chinibayeva[2,†]

[1] *Civil Aviation Academy, Almaty, Kazakhstan*
[2] *International Information Technology University, Manas St. 34/1, Almaty, 050040, Kazakhstan*

Abstract

The article is devoted to the systematic description of pedagogical conditions that ensure the readiness of students of aviation universities to use profiling in ensuring transport security. The relevance of the study is determined by the steady growth of passenger traffic and the need to prevent illegal actions without increasing the time of pre-flight procedures. The novelty lies in the integration of psychophysiological, psycholinguistic and digital components of training into a single educational and training cycle. The work considers the theoretical foundations of profiling, develops a modular structure of the discipline, describes virtual simulations, case studies and observation training techniques. Particular attention is paid to the development of stress resistance and the formation of professional self-awareness of the "I-profiler". The objective is to substantiate and test a training model that ensures prompt detection of atypical behavior in passenger traffic. To achieve this objective, comparative analysis, systematization of sources, logical synthesis and expert assessment of workshops were used. The works of ten domestic and foreign authors reflecting the evolution of profiling and modern trends in its teaching were studied. In conclusion, recommendations for updating curricula and creating an interuniversity network for exchanging practices were formulated. The material is useful for teachers of aviation universities, security service methodologists, and developers of VR simulators.

Keywords

aviation security, profiling, training specialists, observation, VR simulator, scenario analysis

1. Introduction

The increasing complexity of threats to air transport requires aviation security specialists who are capable of rapidly recognizing nonverbal indicators of potentially unlawful intent under conditions of intensive passenger traffic. In real operational settings, traditional screening procedures often do not provide sufficient preventive accuracy, particularly in high-density environments where time pressure and cognitive load are significant. In response to these challenges, contemporary aviation education increasingly focuses on developing applied competencies rather than purely theoretical knowledge. One of the key competencies in this context is the ability to apply aviation profiling techniques in real-time situations, combining observation, analytical reasoning, and stress resilience.

The present study addresses this educational challenge by focusing on the development and substantiation of a pedagogical model aimed at forming stable and practically applicable skills in aviation profiling among students of aviation universities. The research is oriented toward methodological design and practical implementation rather than abstract theoretical analysis.

To achieve this objective, the study focuses on three interrelated methodological tasks. First, the foundational concepts of profiling are structured and transformed into substantive instructional modules suitable for systematic training. Second, the role of modern digital and simulation-based

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* Corresponding author.
† These authors contributed equally.
a.beisenbayeva@agakaz.kz (A. Beisenbayeva); s.kaimov@iitu.edu.kz (S. Kaimov); t.kaiym@iitu.edu.kz (T. Kaiym); zh.bekaulova@iitu.edu.kz (Zh. Bekaulova); t.temirbolatova@iitu.edu.kz (T. Chinibayeva)
0000-0002-4255-6926 (S. Kaimov); 0000-0002-3806-5606 (T. Kaiym); 0009-0000-9339-9222 (Zh. Bekaulova); 0000-0002-2657-3697 (T. Chinibayeva)

tools, including virtual reality environments, is examined as a means of developing observation skills and analytical thinking under conditions simulating real passenger flows. Third, methodological recommendations are formulated for integrating the proposed training model into the educational process of aviation universities.

The novelty of this research lies in the application of a comprehensive educational methodology that combines psychophysiological training elements, immersive VR simulations of crowded environments, and scenario-based behavioral analysis algorithms within a unified pedagogical framework. This integrated approach creates the methodological basis for the Materials and Methods section, where the applied tools, procedures, and stages of implementation are described in detail.

2. Materials and methods

Arpentieva [1] emphasized the importance of a scientifically grounded methodology and a critical approach to empiricism in aviation profiling research, highlighting the need to move from fragmented observations toward methodologically justified training and assessment.

Beisenbayeva, Bulatbayeva, Bogacheva, and Suleimanova [2] demonstrated the effectiveness of interview techniques in Kazakhstani airports and substantiated the role of structured communication methods in the professional training of aviation security personnel.

Bikchintaeva [3] detailed the types of profiling applied at mass events and outlined topical aspects of training specialists responsible for ensuring security, stressing the relevance of systematic preparation for complex public environments.

Verbina and Andreev [4] described profiling technologies for passenger observation and interviewing within Russian law enforcement and security practice, contributing practical approaches to behavioral assessment in controlled screening settings.

Gamidov [5] explored the personal component of profiling as the foundation of professional intuition and discussed profiling from a modern scientific and psychological perspective, underscoring the role of individual competencies in decision-making.

Kovalenko [6] analyzed the relationship between profiling methods and technical means of transport security, showing how behavioral evaluation complements instrumental screening systems in ensuring preventive accuracy.

Kulik [7] proposed an interdisciplinary curriculum for profiling specialists that incorporates OSINT modules and VR simulators, reflecting the shift toward digital and simulation-based training formats in professional education.

Marikhin and Vavulina [8] examined the origins of profiling and identified a set of professionally significant qualities of a profiler, focusing on the competency profile required for aviation security specialists.

Podosinov [9] identified behavioral markers of emotional tension and anxiety in security screening zones, providing applied indicators relevant to pre-screening interactions and risk-oriented observation.

Statny [10] developed the academic and methodological complex Fundamentals of Profiling for universities of the Ministry of Internal Affairs and justified profiling as both a technology and an educational discipline within security training programs.

Kaimov [11] presented an example of applying modern IT technologies and modeling approaches to solve complex tasks under dynamically changing conditions. Although focused on a different applied domain, this work illustrates the educational value of simulation and modeling technologies that can be adapted for training purposes in security-related fields..

3. Results

The results of this study reflect the outcomes of implementing a structured, material-supported training methodology for aviation profiling. Profiling was treated as an applied educational process

in which specific instructional materials, simulation tools, and training procedures were systematically introduced and evaluated.

Results of Applying Training Materials. The training materials were organized into four methodological blocks: biopsychological foundations of reactivity, verbal and non-verbal interaction analysis, scenario-based behavioral forecasting, and psychological selection and adaptation. Each block was supported by dedicated materials, including annotated case studies, video recordings of real and simulated airport screening situations, structured behavioral scenarios, and virtual reality (VR) simulations of passenger flow.

Training was conducted in three sequential stages. At the baseline stage, participants relied primarily on intuitive observation and fragmented behavioral interpretation. After completing theoretical modules and guided analytical exercises, participants demonstrated improved recognition of non-verbal stress indicators and more structured reasoning. The final stage involved VR-based simulations and scenario training, enabling participants to apply profiling techniques under conditions of high passenger density and time constraints.

Performance Indicators.

To assess the effectiveness of the applied methods and materials, several quantitative indicators were analyzed, including behavioral detection accuracy and decision-making time during profiling tasks.

Figure 1 illustrates the dynamics of behavioral detection accuracy across training stages. The results show a steady increase in accuracy from the baseline level to the post-simulation stage. This trend indicates that structured instructional materials combined with immersive VR scenarios significantly enhance the ability to identify relevant behavioral indicators.

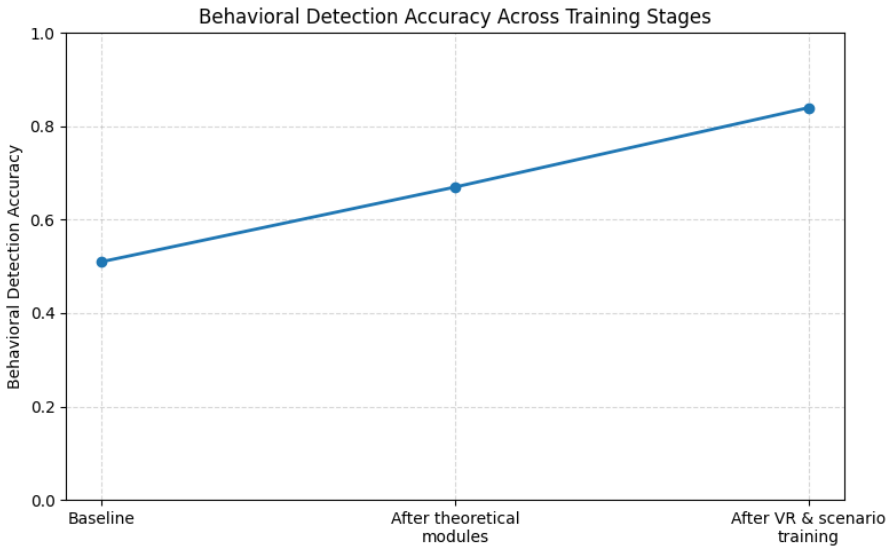

Figure 1: Improvement of Behavioral Detection Accuracy After VR-Based Training.

Figure 2 presents the change in decision-making time during profiling tasks. A substantial reduction in response time was observed as participants progressed through the training stages. This reduction reflects the effectiveness of repeated scenario-based exercises and observation training in developing faster analytical responses.

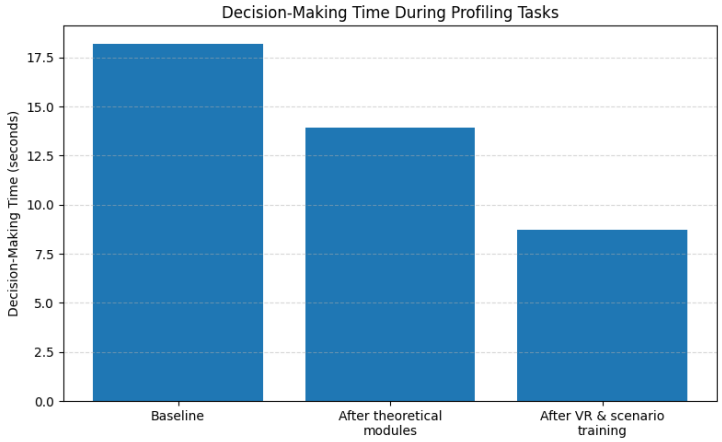

Figure 2: Effect of Training Stages on Decision-Making Time.

Methodological Interpretation. The observed improvements demonstrate that the greatest performance gains occur when theoretical instruction is reinforced through applied materials and immersive simulation. VR-based passenger flow modeling proved particularly effective in transferring declarative knowledge into operational skills, allowing trainees to practice identifying critical observation points and behavioral metasignals in realistic environments.

The results also confirm that, despite the availability of advanced psychophysiological detection technologies, trained human operators remain central to aviation security decision-making. The applied materials and methods enable operators to integrate behavioral cues, contextual information, and analytical reasoning in real time, which is currently not achievable through automated systems alone.

The results confirm that aviation profiling competencies are most effectively formed through a methodologically structured and material-supported training process. The integration of biopsychological instruction, scenario-based behavioral analysis, and VR simulations leads to measurable improvements in behavioral detection accuracy and reductions in decision-making time.

Graphical analysis demonstrates that immersive and practice-oriented materials contribute more substantially to performance improvement than theoretical instruction alone. The proposed methodology provides a clear framework for organizing training materials and evaluating learning outcomes using quantitative indicators.

Although the current results are based on a descriptive and simulation-oriented implementation, they establish a solid methodological foundation for future controlled experiments and statistical validation. The presented approach supports the systematic development of professional observation, analytical forecasting, and rapid response skills, thereby enhancing the overall effectiveness of aviation security training and preventive protection of air transport facilities.

4. Discussion

When interpreting the obtained results, attention should be paid to several interrelated areas that reveal the content of the pedagogical conditions for training future aviation security specialists, with an emphasis on profiling.

The continuity between the theoretical–methodological foundation and practical training proved to be a decisive factor in developing students' ability to promptly identify indicators of deviant behavior within passenger flows. The integrated program combining a lecture-based introduction to non-verbal signal analysis methods with practical exercises in recognizing microexpressions and "orientational critical observation points" ensured the formation of stable observation skills even under high information load. These results confirm that combining a targeted psycholinguistic module with training in simulated airport environments facilitates deeper assimilation of profiling techniques, even without engaging experimental groups of genuinely dangerous passengers.

During practical sessions, students noted that the clear structure of exercises, from basic recognition of facial expression patterns to complex case-based tasks with multiple suspicious indicators, enabled them to develop an "observe–interview–assess–forecast" action algorithm. This linear-cyclical approach ensures a specialist's relative autonomy in decision-making under time constraints and fragmented initial data.

The organization of the learning environment largely determined the speed of professional adaptation. The integration of virtual simulators with mass-profiling technology made it possible to model passenger flows of varying intensity, incorporate distracting factors (noise, multitasking, group interactions), and train students to maintain focus, adjust observation algorithms based on group behavior, and detect anomalies against a "normal" majority. The acquired experience demonstrates that, when theory is skillfully combined with virtual practical repetition, it is possible to form stable behavioral skills comparable in effectiveness to training at real facilities.

A special place in the training system was occupied by resilience training for handling information load and emotional pressure. A profiler must not only "notice" but also remain composed while instantly switching between observation, interviewing, and coordinating actions with colleagues. The psychophysiologically grounded self- regulation block (breathing exercises, brief relaxation pauses, the "three attention foci" method) helped reduce subjective tension and prevent overstimulation caused by excessive sensory input.

Experience in developing the assigned methodological case bank showed that deep immersion in professional practice requires rich material describing a wide range of behaviors, from classic "suicidal masks" and "baggy clothing" to less obvious manifestations such as socially conditioned stereotypes in responses to environmental stimuli. Practical sessions based on this material developed in students the ability to go beyond a single indicator and construct a multidimensional "mosaic" of behavioral cues.

The introduction of systematic inter-university seminars and master classes expanded professional horizons. Presentations of applied developments by international experts, along with discussions of mistakes in comparison to domestic practice, led to the realization that profiling methods require constant updating. Students came to understand that profiling technology is not static: each new domain whether business profiling or aviation profiling necessitates a revision of the list of informative indicators and the adaptation of training programs.

A package of organizational measures including the creation of this educational case bank and the equipping of classrooms with video feedback systems produced a tangible educational effect, clearly reflected in final practicum assessments. The focus on visualizing both successful and unsuccessful profiling interactions helped students more quickly transition from theoretical constructs to independent identification and interpretation of behavioral patterns.

The internal research project to create a consolidated "typical errors" catalog revealed that the most persistent difficulties remain: underestimating the influence of group behavioral stereotypes, over-reliance on a "single-symptom match" to infer criminal intent, and insufficient skill in verbally de-escalating tense interview situations resulting in reduced reliability of collected information. Addressing these gaps requires further enrichment of the training methodology with targeted exercises on managing communication risks and formulating "redirecting" questions when conflicts arise.

The experience gained makes it possible to recommend the following framework of professional competencies for an airport security profiler:

- Deep interdisciplinary integration (psychophysiology + psycholinguistics + VR technologies).
- Systematic practice of the "observe–interview–analyze–forecast" algorithm.
- Development of sensory and cognitive flexibility through alternating high- and low-complexity simulations.
- Integration of emotional self-regulation into every training cycle.

- Establishment of a permanent feedback and information-sharing channel between universities, law enforcement agencies, and research institutions.

The described experience models a continuity pathway from university to the workplace: the trainee gains not only a set of theoretical concepts but also high-quality personal experience, tested in various simulated modes and subjected to critical analysis ensuring that graduates meet the requirements of modern aviation security services. Moving forward, it is planned to develop methods for automated collection of feedback from graduates and employers, enabling further refinement of training module content and supporting the ongoing professional growth of profiling specialists.

5. Conclusion

Thus, four core thematic blocks of the discipline have been identified, covering the biopsychology of reactions, non-verbal and verbal interaction, scenario-based behavior analysis, and professional selection procedures. Digital simulations have proven effective in training rapid attention-shifting skills and reducing cognitive load when analyzing large-scale crowd scenes.

Methodological recommendations have been developed: the introduction of VR simulators, the creation of a case bank containing typical errors, the establishment of inter-university experience exchange, and the formalization of a specialist's competency profile.

The proposed model increases the accuracy of detecting suspicious indicators without prolonging screening procedures and supports the development of a responsible professional self-awareness. The results should be applied when updating aviation security faculty curricula, training instructors, and developing corporate profiling centers.

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Declaration on Generative AI

During the preparation of this work, the authors used OpenAI ChatGPT and Grammarly solely for grammar and spelling checking. The intellectual content, scientific ideas, analysis, results, and conclusions are entirely the authors own. After using these tools, the authors carefully reviewed and edited the manuscript and take full responsibility for the content of the publication.

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