

Human Factors and Analysis of Aviation Education Content of Military Pilots

R. Rozenberg*, S. Ďurčo*, P. Kaľavský*, M. Antoško*, V. Polishchuk*, J. Jevčák*, L. Choma*,
and A. Tobisová**

* Faculty of Aeronautics, Technical University of Košice/Department of Flight preparation, Košice, Slovakia

** Faculty of Aeronautics, Technical University of Košice/Department of Air Traffic Management, Košice, Slovakia
robert.rozenberg@tuke.sk, stanislav.durco@tuke.sk, peter.kalavsky@tuke.sk, matej.antosko@tuke.sk,
v.polishchuk87@gmail.com, jaroslav.jevcak@tuke.sk, ladislav.choma@tuke.sk, alica.tobisova@tuke.sk

Abstract—Aviation education is a complex pedagogical process, which we perceive as a didactic system for the creation of personnel competencies to perform aviation professions. Increasing the quality of education requires effective use of the experience and needs of aviation practice. The aim of the article is to examine the content of aviation education of military pilots at the selected institutions from 1973 to the present using the analysis for the quality teaching process and the interaction of edutants (human factors) teachers and students. The article is the first part of the study on the issue of aviation education, which answers the question of strengths and weaknesses, risks and opportunities for quality content. The result is knowledge applicable in the creation of content for new study programs of the Faculty of Aeronautics of the Technical University in Košice.

I. INTRODUCTION

The aviation education as a didactic system in a specific environment of human activity is determined by the general, special and unique educational and training objectives of the preparation of aviation personnel. The content of aviation education must reflect the established requirements for aviation capabilities.

The content of paper will be included in the first part of feasibility study on the issue of military pilots' aviation education, which answers the questions of the research for the Ministry of Defence of the Slovak Republic.

The first part of feasibility study was focused on the content of military pilot training as the specific educational agenda. The subject of the research was the content of aviation education of military pilots carried out at the institutions since 1973 in Slovakia until now at the Faculty of Aviation of the Technical University in Košice (FA).

The second part of feasibility study was focused on the examination of the methods, forms and didactic means of aviation education of military pilots at the selected institutions from 1973 to the present using the analysis for the quality teaching process and the interaction of edutants (human factors) teachers and students.

The third part of the feasibility study is focused on the examination (identification, analysis and evaluation) of historical data from 1959-2019 for the risks of aviation personnel training plans based on the objective and proven facts, without the influence of ideology, the group or individual interests, the future contracts and public procurement to „the selected institutions“, but only for the public interest of the state.

The fourth part of feasibility study will be focused on the exploring the modern areas of aviation education today and their development prospects.

The fifth part of the feasibility study will be focused on the processing of proposals for the prospective training of Slovak Air Force personnel and the proposals for the preparation of study programs of the Faculty of Aeronautics of the Technical University for our new accreditation. The study will also include proposals for the personnel, material, technical and financial provision of modern aviation education in Slovakia.

The main scientific motive of our pre-research and historical data analysis is to acquire the knowledge applicable to the creation of new study programs of the Faculty of Aeronautics of the Technical University of Košice (FA) in the study field Transport according to the new descriptions approved by the Accreditation commission.

II. PROBLEM IDENTIFICATION

The quality of teaching process and the interaction of the edutants (human factors) teachers and students are the implementation platform of aviation education, where one of the basic didactic elements of which is CONTENT (theoretical preparation). [1]

The content of military pilot training is a specific educational agenda. The subject of the research is the content of aviation education of military pilots carried out at the institutions since 1973 in Slovakia until now at the Faculty of Aeronautics of the Technical University in Košice (FA).

III. METHODOLOGY OF PROBLEM SOLVING

The historical and content analysis of study programs of aviation education of military pilots from 1973 within Czechoslovakia, or from 1993 within Slovakia, will allow

the investigation (identification, analysis and evaluation) of data.

The research databases are divided into the years 1973-1990, 1990-2004, 2004-2019 and 2019-2025, within the aviation education in Košice.

The research is focused on the structure and hourly subsidy of subjects of aviation education as well as the comparison of the percentage of groups of subjects in study programs.

The method of comparison, synthesis, induction and deduction will support the formulation of preliminary conclusions of the forthcoming study in this section.

IV. DISCUSSION AND RESULTS

The final version of the study, which will have a minimum of 5 subchapters within the analytical section, will be part of the internationally created *Expert Database of Civil and Military Aviation Experience* in the fields of:

- Academics subjects,
- Simulation and modelling of Security issues, as in [2-7],
- Technical Sciences, as in [8-17],
- Civil/ Military / Air Force management, education and training etc. as in [15-32].

The results of the study of large amounts of study programs in 1973 to the present, with a prediction up to 2025, are concentrated in transparent tables (subjects, Σ hours) for academic discussion and conclusions.

TABLE I
STUDY PLAN DAILY 4 - YEARS
STUDY IN THE PERIOD: 1973 - 1990

Subjects	Σ
Mathematics I	80
Mathematics II	60
Physics I	60
Physics II	60
Descriptive geometry and technical drawing	40
Flexibility and strength	60
Material Science	40
Machine parts	50
Electrical engineering	40
Summary block I	490
Aerodynamics and Flight Mechanics	120
Aviation Meteorology	80
Air Navigation and Geography	80
Combat shooting and bombing	80
Means of radio communication	40
Aircraft design	80
Aircraft engines	60
Thermodynamics	60
Armament of aircraft	40
Summary block II	640
Tactics of fighter aviation	80
Helicopter Air Force Tactics	60

Radio-electronic warfare	40
Foreign armies	60
Protection against weapons of mass destruction	30
Summary block III	270
Shooting preparation	60
Parachute preparation	60
Physical education	80
Special physical education	60
Aviation Physiology	20
Summary block IV	280
The History of the International Workers' Movement	80
Marxist-Leninist Economics	80
Marxist-Leninist philosophy	60
Scientific Communism	40
Summary block V	260
Summary theoretical preparation	1940
Basic military training	180
Flight training and aviation-methodological preparation	1500
Summary study programme	3620

TABLE II
STUDY PLAN DAILY 5 - YEARS
STUDY IN THE PERIOD: 1990 - 2004

Subjects	Σ
Mathematics	180
Physics	80
Computer programming and usage	120
Summary block 1	380
Aerodynamics and Flight Mechanics	160
Aviation Meteorology	80
Air Navigation and Geography	160
Navigator preparation	60
Combat shooting and bombing	180
Automated sys. management and command	170
Radiocommunication means	60
Military Topography	60
Radio-electronic warfare	40
Air Force Logistics Support	60
Air weapon and navigation systems	40
Summary block 2	1070
Air Force Tactics	200
Air Force Management	90
Air Traffic Management and safety	120
Air Force combat effectiveness	50
Operational analysis	70
Aviation technology	200
Parachute preparation	82
ICAO Aviation Regulations	230
Aviation Physiology	20
Summary block 3	1062
Military history of Slovakia - history of wars	30

Philosophical problems of war and army	30
Language culture and rhetoric	30
Army Sociology	40
Military Pedagogy and Psychology	60
Military professional ethics	20
Economics	40
General and military law	60
Basics of management	60
English language	500
Select foreign language	120
Summary block 4	990
Basic military training	160
Summer Training Camp I	120
Ski Training, Summer Training Camp II	120
Concentrated military prof. preparation	40
Shooting preparation	48
General tactics	80
Foreign armies	90
Radio chemical and biological protection and ecology	70
Physical education	296
Basics of external ballistics	30
Summary block 5	1054
Summary theoretical preparation	4556
Flight training and aviation-methodological preparation	1512
Summary study programme	6068

TABLE III.
STUDY PLAN DAILY 3 YEARS
BACHELOR STUDY: 2004 - 2019

Compulsory subjects	Σ
Mathematics I	52
Physics I	39
Basics of Informatics	39
Aviation Meteorology I	39
Air Law	26
English language I	52
Air Communication	26
Basics of cartography	26
Physical education I	26
Mathematics II	39
Physics II	39
Basics of Flight I	52
Air Navigation I	52
Aviation Meteorology II	39
English language II	52
Aviation Regulations I	39
Physical education II	26
Basics of Flight II	39
Aviation engines I	26
Air Navigation II	39
Aeroplanes	39
Aircraft performance	39
Avionics I	39
Aviation Electronic Systems	39
English language III	52
Physical education III	26
Weight and balance of aircraft	52
Aviation Regulations II	39
Airports	26

English language IV	39
Telesná výchova IV	26
Aviation engines II	39
Avionics II	39
Human performance and constraints	39
Flight Planning and Monitoring	52
Operating procedures	39
English language V	39
Air Transport Economics	39
Basics of Management	52
Search and Rescue Service	39
English language VI	39
Bachelor thesis	104
Summary compulsory subjects	1703
Selected subjects	Σ
Physics Seminar I	26
Physics Seminar II	26
Mathematics Seminar I	26
Mathematics Seminar II	26
Selected foreign language I	26
Selected foreign language II	26
Aircraft handling equipment	39
Basics of Logistics	39
Selected foreign language III	26
Physical education V	26
Summary selected subjects	286
Summary theoretical preparation	1989
Flight training and aviation-methodological preparation	1100
Summary study programme	3089

TABLE IV.
STUDY PLAN DAILY 3 YEARS
BACHELOR STUDY: 2019 -

Compulsory subjects	Σ
Air Law	44
Economics	44
Informatics	55
Airports and Transport infrastructure	55
Physical education I	22
Air Traffic management I	44
Avionics I	33
Equipment and systems I	44
Air Communication	33
Aviation Regulations	44
Physical education II	22
Mathematics	55
Physics	55
Search and Rescue Service	22
Aviation Meteorology I	33
Air Navigation I	44
Air Communication	22
Term project I	33
Aviation Meteorology II	33
Air Navigation II	44
Air Traffic Management II	33
Basics of Flight I	33

Aviation engines	33
Aircraft design	33
Commercial air transport operating procedures	33
Basics of Flight II	44
Flight performance	33
Avionics II	33
Flight Planning and Monitoring	44
Final thesis	99
Air transport process	44
Weight and balance	33
Human performance and constraints	22
Summary compulsory objects	858

Selected subjects	E
English language I	33
Introduction to Mathematics	22
Introduction to Physics	22

English language II	22
Aerodynamika vrtuľníka	22
Selected foreign language	22
Simulačný výcvik pilotov I	22
Physical education III	22
Accounting	22
Simulator Training of Pilots II	22
Physical education IV	22
Physical education V	22
Simulator Training of Pilots III	22
Physical education VI	22
Summary selected subjects	275
Summary compulsory objects	1133
Flight training and aviation-methodological preparation	1100
Summary study programme	2233

Evaluation and comparison of obtained data from study programs can be expressed as follows:

TABLE V.
COMPARING THE RANGE OF CLASSES OF SUBJECT GROUPS IN THE FLIGHT EDUCATION PLANS OF PILOTS

Subject groups	Number of hours from compulsory subjects			
	Periods			
	1973 – 1990	1990 – 2004	2004 – 2019	2019 – 2025
Mathematical-physical and theoretical foundations	490	380	208	253
Basic vocational and transport subjects	640	1300	923	539
Physical preparation	200	378	104	44
English	0	500	234	22
Flight training and aviation-methodological preparation	1500	1512	1100	1100

TABLE VI.
COMPARISON OF PERCENTAGE OF SUBJECT GROUPS IN STUDY PLANS (PERIODS)

Subjects ogroups	Percentage of compulsory subjects			
	Periods			
	1973 – 1990	1990 – 2004	2004 – 2019	2019 – 2025
Mathematical-physical and theoretical foundations	20	6	7	11
Basic vocational and transport subjects	18	21	30	24
Physical preparation	6	6	3	2
English	0	8	8	2
Flight training and aviation-methodological preparation	41	25	36	50

V. CONCLUSION

Our research databases were divided into the years 1973-1990, 1990-2004, 2004-2019 and 2019-2025, air education in Košice.

The restrictions for comparative research databases: different years of continuous professional pilot training.

The interpretation of results and data included in the tables, the examining and comparing data allow us to formulate the following partial conclusions in the field of military pilot air education content in the researched periods:

- The most hours of Key Subjects Flight Training and Aeronautical Training (1512 hours) was conducted over the period 1990-2004,
- The most English lessons (500 hours) and physical training (378 hours) were between 1990-2004,
- The most hours of subject groups Basic vocational and transport subjects (1300 hours) were in the period 1990-2004,
- The most hours of subject groups Mathematical-physical and theoretical foundations (490 hours) were realized in the period 1973-1990,
- The largest percentage of subject groups Flight Training and Aerospace Training (50%) is planned for 2019-2025,
- The largest percentage of English (8%) was in the period 1990-2004 and 2004-2019,
- The largest percentage of physical training (6%) was in 1973-1990, and 1990-2004,
- The largest percentage of subject groups Basic vocational and transport subjects (30%) was in 2004-2019,
- The largest percentage of subject groups Mathematical-physical and theoretical foundations (20%) were realized in the period 1973-1990,
- The most significant change in the formation of competencies of future pilots is identified in the increase of the percentage of subject groups Flight training and aerospace training from the current 36% to 50%.

The paper reached the aim of the article to examine the content of aviation education of military pilots at the selected institutions from 1973 to the present using the analysis for the quality teaching process and the interaction of edutants (human factors) teachers and students.

The future research in the area will be focused on the flight crew performance measurements.

ACKNOWLEDGMENT

The paper was prepared within project APVV 17-0167 Application of self-regulatory methods in preparation of flight crews.

REFERENCES

[1] S. Szabo et al. *Proposal of new description of study field No. 6 Transport*. Košice: LF TUKE, 2018. 3 p.
 [2] P. Fuchs, P. Novak, T. Saska, J. Smida, Z. Dvorak, M. Kelemen, and R. Sousek, "Simulation of dangerous substances

outflows into the environment because of traffic accidents by dangerous substances transport", in WMSCI 2010: the 14th world multi-conference on systemics, cybernetics and informatics: proceedings volume 1: June 29th - July 2nd, 2010, Orlando, Florida, USA: International Institute of Informatics and Systemics, 2010, pp. 204-207.
 [3] Z. Dvorak, Z. Cekerevac, M. Kelemen, and R. Sousek, "Enhancing of security on critical accident locations using telematics support", in ICSIT 2010 - International conference on society and information technologies: proceedings April 6th-9th, 2010, Orlando, Florida, USA: International Institute of Informatics and Systemics, 2010, pp. 414-417.
 [4] M. Balatka, P. Fuchs, J. Kamenicky, R. Sousek, and M. Kelemen, "Exposure of the environment and surface water by dangerous liquid - the slop outflow model", in Proceedings Volume III The 15th World Multi-Conference on Systemics, Cybernetics and Informatics July 19th - July 22nd, 2011, Orlando, Florida, USA: International Institute of Informatics and Systemics, 2011, pp. 280-284.
 [5] M. Kelemen, and M. Blišťanová, "Logistic Modelling to handle the Threat of Floods - The Bodva River example", in SGEM 2014: 14th International Multidisciplinary Scientific GeoConference: Conference Proceedings Volume III: 17-26 June, 2014. Sofia, Bulgaria: STEF92 Technology, 2014, pp. 715-723.
 [6] J. Vágner, and E. Pappová, "Comparison of Radar Simulator for Air Traffic Control", in Naše more, vol. 61, Issue: 1-2, pp. 31-35. March 2014.
 [7] H. Pavolová, and A. Tobisová, "The Model of Supplier Quality Management in Transport Company", in Naše more, vol. 60, Issue: 5-6, pp. 123-126. November 2013.
 [8] P. Nečas, and M. Kelemen, "Call for more security: Technology revolution wanted", in ICMT '09 [elektronický zdroj]: International conference on Military Technologies 2009: 5 to 6 May 2009, Brno. Brno: University of Defence, 2009, pp. 246-250.
 [9] P. Bučka, and M. Kelemen, "Requirements related to the Slovak Republic's Air Force", in ICMT '09 [elektronický zdroj]: International conference on Military Technologies 2009: 5 to 6 May 2009, Brno. Brno: University of Defence, 2009, pp. 282-289.
 [10] R. Andoga, L. Fozo, J. Judicak, R. Breda, S. Szabo, R. Rozenberg, and M. Dzunda, "Intelligent Situational Control of Small Turbojet Engines", in INTERNATIONAL JOURNAL OF AEROSPACE ENGINEERING, Hindawi, Vol. 2018, 16 pp. Jun 2018.
 [11] M. Dzunda, N. Kotianova, "Selected Aspects of Applying Communication Technology to Air Transportation" in: International Conference on Computer Science and Information Engineering (CSIE) Location: Bangkok, THAILAND Date: JUN 28-29, 2015, p. 1-7
 [12] R. Rozenberg, V. Socha, L. Socha, S. Szabo, and V. Nemec, "Critical elements in piloting techniques in aerobatic teams", in 2016 Transport Means - Proceedings of the International Conference, Kaunas, Lithuania: Kaunas University, pp. 444-449.
 [13] M. Dzunda, A. Hrban, "Accuracy of the passive tracking systems" in: 12th International Conference on Microwaves and Radar (MIKON98) Location: KRAKOW, POLAND Date: May 20-22, 1998, p. 216-220
 [14] S. Đurčo, J. Sabo, R. Rozenberg, and Ž. Miženková, "Means of CPDLC using with ATC procedures in terminal maneuvering area", in 2017 Distance Learning, Simulation and Communication 2017. Brno: University of Defence, 2017, pp. 62-67.
 [15] M. Dzunda, N. Kotianova, K. Holota, et al, "Use of Passive Surveillance Systems in Aviation" in: Marine Navigation and Safety of Sea Transportation. Published: 2015. P. 249-253
 [16] P. Nečas, M. Kelemen, and M. Sopóci, "Information operations and media: Beyond the Security Scope?", in 15th International Conference the Knowledge-based Organization: Military Sciences. Security and Defence, Conference Proceedings 1, Nicolae Balcescu Land Forces Academy, Nov

- 26-28, 2009, Sibiu, Romania: Nicolae Balcescu Land Forces Academy, 2009, pp. 96-103.
- [17] P. Kaľavský, V. Socha, L. Socha, P. Kutilek, J. Gazda, and M. Kimličková, "Conditions for Abandonment Out of a Helicopter Using Personal Rescue Parachute", in International Conference on Military Technologies Location: OPROX, Inc., Brno, CZECH REPUBLIC MAY 19-21, 2015, Faculty of Military Technology, the University of Defence in Brno; Czechoslovakia Section of IEEE; OPROX, Inc. Book Series: INTERNATIONAL CONFERENCE ON MILITARY TECHNOLOGIES. Brno: University of Defence, 2015, pp. 467-471.
- [18] M. Sopóci, M. Kelemen, and P. Nečas, "Military Management in 21 century and Transformation of Army", in 15th International Conference the Knowledge-based Organization: Military Sciences. Security and Defence, Conference Proceedings 1, Nicolae Balcescu Land Forces Academy, Nov 26-28, 2009, Sibiu, Romania: Nicolae Balcescu Land Forces Academy, 2009, pp. 138-142.
- [19] M. Kelemen, S. Szabo, and I. Vajdová, "Cybersecurity in the Context of Criminal Law Protection of the State Security and Sectors of Critical Infrastructure", CNDCGS 2018 International Scientific Conference, 25.04.2018-27.04.2018, Litva, Challenges to national defence in contemporary geopolitical situation: proceedings / Bekesiene, S. (editor); Hošková-Mayerová, Šárka (editor). - Vilnius (Litva): The General Jonas Žemaitis Military Academy, 2018. - ISSN (online) 2538-8959, pp. 100-104.
- [20] M. Kelemen, J. Drotárová, D. Kačiková, and M. Bodor, "Perception of security and safety need: voluntary fire protection as a part of volunteering on Slovak Republic", *Journal of Security and Sustainability Issues* 5(4): 589-599. [https://doi.org/10.9770/jssi.2016.5.4\(11\)](https://doi.org/10.9770/jssi.2016.5.4(11))
- [21] M. Kelemen, S. Szabo, and I. Vajdová, "Security Management in the Air Transport: Example of an Interdisciplinary Investigation of Special Security Questions", CNDCGS 2018 International Scientific Conference, 25.04.2018-27.04.2018, Litva, Challenges to national defence in contemporary geopolitical situation: proceedings / Bekesiene, S. (editor); Hošková-Mayerová, Šárka (editor). - Vilnius (Litva): The General Jonas Žemaitis Military Academy, 2018. - ISSN (online) 2538-8959, pp.105-108.
- [22] M. Kelemen, J. Jevčák, "Security Management Education and Training of Critical Infrastructure Sectors' Experts", in the New Trends in Aviation Development NTAD 2018: The 13th International Scientific Conference, Proceedings, 28 November 2018 / Rudolf Andoza. (ed.) - Danvers (USA): Institute of Electrical and Electronics Engineers, 2018. - ISBN 978-1-5386-7917-3, pp. 68-71. DOI: 10.1109/NTAD.2018.8551687
- [23] V. Polishchuk, and M. Kelemen, "Information Model of Evaluation and Output Rating of Start-up Projects Development Teams", in Luengo, D. et al. (ed.) Proceedings of the Second International Workshop on Computer Modeling and Intelligent Systems (CMIS-2019), Zaporizhzhia, Ukraine, April 15-19, 2019. CEUR Workshop Proceedings Vol. 2353, CEUR-WS.org 2019, pp. 674-688.
- [24] M. Kelemen, "Security of the Slovak Republic and issues of protected interests: Security and criminal law research topics", in: *Fire protection, Safety and Security 2017. International Scientific Conference Proceedings*, May 3rd. - 5th, 2017, Zvolen, Slovak Republic. Editors Majlingová, A, Veľková, V. Zvolen: Technical university, 2017. pp. 312-316. ISBN 978-80-228-2957-1
- [25] J. Drotárová, D. Kačiková, M. Kelemen, and M. Bodor, "The possibilities of using blended learning in fire safety education", in: CBU international conference proceedings 2016: innovations in science and education: March 23-25, in Prague, Czech Republic. Vol. 4; eds. Tavleen Sahota, Mary-Anne Jones. - ISBN 978-80-88042-05-1. - ISSN 1805-997X. pp. 283-286.
- [26] V. Polishchuk, M. Kelemen, and J. Koziba, "Technology Improving Safety of Crowdfunding Platforms Functioning in the Context of the Protection of the Start-Up Investors in the Financial and Transport Sectors", *Journal of Konbin*, Vol. 49 no. 1(2019), pp. 313-330, 2019 /2083-4608/
- [27] M. Kelemen, M. Pilát, S. Makó, R. Rozenberg, and A. Tobisová, "Pricing Policy Aspects in Competitive Fight Between Low-Cost Airlines on Kosice Airport", *Journal of Konbin*, Vol. 49, no. 1(2019), pp. 331-342.
- [28] R. Urban, M. Štroner, P. Blištan, L. Kovanič, M. Patera, S. Jacko, I. Duriška, M. Kelemen, and S. Szabo, "The Suitability of UAS for Mass Movement Monitoring Caused by Torrential Rainfall - A Study on the Talus Cones in the Alpine Terrain in High Tatras, Slovakia", *ISPRS Int. J. Geo-Inf.* 2019, 8, 317. doi:10.3390/ijgi8080317
- [29] S. Szabo, S. Makó, A. Tobisová, P. Hanák, and M. Pilát, "Effect of the load factor on the ticket price", *Problemy Transportu = Transport Problems: International Scientific Journal*. Gütvice (Polsko): Politechnika Śląska Roč. 13, č. 3 (2018), pp. 39-47. Available online: http://transportproblems.polsl.pl/pl/Archiwum/2018/zeszyt3/2018t13z3_04.pdf.
- [30] S. Szabo, M. Pilát, A. Tobisová, and S. Makó, "Operational statistics of Kosice Airport, in *Scientific Journal of Silesian University of Technology: Zeszyty Naukowe Politechniki Śląskiej: Series Transport: Seria Transport*. Katowice (Polsko): Wydział Transportu č. 102 (2019), pp. 197-203. Available online: http://sjsutst.polsl.pl/archives/2019/vol102/197_SJSUTST102_2019_SzaboPilatTobisovaMako.pdf.
- [31] P. Kaľavský, R. Rozenberg, P. Petříček, L. Socha and V. Socha, "Helicopter emergency medical services response time in the Central European Region", in *New Trends in Aviation Development 2018: The 13. International Scientific Conference*. - Danvers (USA): Institute of Electrical and Electronics Engineers, pp. 64-67.
- [32] P. Kaľavský, R. Rozenberg, B. Mikula and Z. Zgodavová, "Pilots' performance in changing from analogue to glass cockpits", in *Transport Means 2018. Part III: proceedings of 22nd International Scientific Conference*. - Kaunas (Litva): Kaunas University of technology, pp. 1104-1109.