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INTERNATIONAL MANAGEMENT OF EU-FUNDED CROSS-BORDER INTERREG PROJECTS

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Abstract: Recent collaborative projects have focused on developing border regions and creating data information tools. The KEEP database has seen growing quality and quantity of cooperation-related information. This study examines the data management framework of EU-funded cross-border INTERREG V-A projects across Slovakia, the V4 countries, Austria, and ENI. Study aims to understand the cooperation dynamics and funding geographies of the recent INTERREG V-A period by analysing cross-border programs involving Slovakia's borders. This includes spatial configurations of funded project cooperation, thematic topics addressed, and territorial contexts such as urbanization levels and border proximity. Study evaluates the advantages and disadvantages of institutional mapping using KEEP data, highlighting its usefulness for data exploration and comparative studies. Additionally, we assess the portal's functionality for academics, emphasizing the need for historical data analysis in regional planning. Our study concludes that KEEP-based institutional mapping is valuable for data exploration and enhancing cross-border cooperation insights.

Keywords: Data Management, Data Platform, EU Project Analytics, INTERREG European Planning Studies.

1 Introduction

This study examines Slovakia's cross-border initiatives with other countries of V4 and Austria, and their involvement using data tools. Specifically, the connections between the spatial arrangements of financed project cooperation is analysed, the thematic themes addressed, and the significance of territorial contexts, particularly regarding urbanization levels and proximity to borders. INTERREG is a prominent European Union initiative aimed at fostering cooperation among regions across national borders. It falls under the European Territorial Cooperation (ETC) goal, which is a crucial component of the EU's cohesion policy. INTERREG's primary objective is to promote harmonious economic, social, and territorial development across the EU by supporting cross-border, transnational, and interregional cooperation projects. Since its inception in 1990, INTERREG has played pivotal role in addressing common challenges, facilitating the exchange of knowledge, and enhancing regional integration¹ (European Commission, 2020). This contributes to the overall cohesion of the European Union, promoting peace and stability in the region. For example, Evrard (2017)² emphasized the importance of territorial cooperation in fostering social ties and regional cohesion, which are essential for building a stable and peaceful Europe.

1.1 Cross border cooperation in V4

The Slovak-Hungarian cooperation has made substantial strides in improving infrastructure, environmental protection, and cultural heritage preservation. Projects under this cooperation have focused on developing transport links, enhancing environmental sustainability, and promoting the rich cultural heritage of the region. This has led to improved accessibility, environmental benefits, and increased tourism, thereby fostering economic growth and social cohesion³ (Bachtler, Ferry, 2018).

¹ European Commission. (2020). The INTERREG Programme: Promoting Cooperation Across Borders. Available at: https://ec.europa.eu/regional_policy/policy/cooperation/european-territorial/cross-border_en

² Evrard, E. (2016). The European Grouping of Territorial Cooperation (EGTC): Towards a Supraregional Scale of Governance in the Greater Region SaarLorLux? *Geopolitics*, 21(3), pp. 513–537. Doi: 10.1080/14650045.2015.1104667

³ Bachtler, J., Ferry, M. (2018). Conditionalities and the Performance of European Structural Funds: A Principal-Agent Analysis of Control Mechanisms in European Union Cohesion Policy. ISBN: 9781315542829

Similarly, the Slovak-Czech cooperation emphasizes regional development through joint projects in transport, education, and healthcare. By working together on these critical sectors, Slovakia and the Czech Republic aim to enhance the quality of life for their citizens, boost regional competitiveness, and foster social inclusion. For example, joint transport projects have improved cross-border mobility and collaborative efforts in education and healthcare resulted in better services and opportunities for the population (Baun, Marek, 2017).⁴ Slovak-Austrian initiatives under INTERREG have concentrated on enhancing economic integration, environmental sustainability, and social cohesion. For instance, projects have aimed at improving cross-border transportation infrastructure, which has facilitated easier movement of goods and people, thereby boosting economic activities and regional connectivity. Additionally, efforts in environmental protection, such as joint initiatives for water management and biodiversity conservation, have strengthened ecological resilience (European Commission, 2020).⁵ Similarly, the Slovak-Polish cooperation under INTERREG has yielded substantial benefits in regional development in infrastructure, promoting sustainable tourism, and protecting natural resources. Environmental initiatives have targeted the preservation of the Carpathian Mountains, fostering biodiversity and mitigating climate change impacts. These projects not only safeguard natural heritage but also create new economic opportunities through eco-tourism (European Commission, 2021).⁶

Cross-border cooperation programmes under INTERREG are crucial for fostering development and integration in the Slovak cross-border regions. By facilitating joint initiatives, they help to overcome barriers that hinder regional growth and contribute to a more cohesive and integrated Europe. One of the key roles these programmes play is in facilitating economic growth. By supporting joint projects that enhance infrastructure, stimulate business activities, and create jobs, they help improve the economic Data Management Framework of EU Funded Cross-Border INTERREG V-A Projects 3 competitiveness of the border regions. For instance, investments in transportation and communication infrastructure can significantly reduce logistical bottlenecks, making it easier for businesses to operate efficiently across borders. Additionally, these programmes often focus on fostering innovation and entrepreneurship, which can lead to the creation of new industries and job opportunities. The pooling of resources and expertise through these programmes enables more efficient and impactful economic development, as evidenced by the significant improvements in local economies reported in various studies (Perkmann, 2003; European Commission, 2020). Moreover, cross-border cooperation projects under INTERREG are essential for bridging economic disparities between regions. Many border regions suffer from economic imbalances, with some areas being significantly less developed than their neighbours. By improving connectivity and promoting regional development, these initiatives create new economic opportunities and enhance regional equity. Improved infrastructure and joint economic activities help in levelling the playing field, ensuring that less developed areas can catch up with more prosperous regions. This not only benefits the border regions but also contributes to the overall stability and prosperity of the involved countries (Dörry & Decoville, 2016; Medeiros, 2018). Another significant aspect of these programmes is their role in fostering social and cultural integration. Many border regions face common environmental challenges such as pollution, deforestation, and water management issues. By addressing these problems collaboratively, regions can implement more effective and sustainable solutions. Joint

⁴ Baun, M., Marek, D. (2017). *The Limits of Regionalization: The Intergovernmental Struggle over EU Cohesion Policy in the Czech Republic*. *East European Politics and Societies*, 31(4), 863–884. <https://doi.org/10.1177/0888325417720717>

⁵ European Commission. (2020). *Territorial Cooperation - Interreg*. Available at: https://ec.europa.eu/regional_policy/en/policy/cooperation/european-territorial/
⁶ not available

environmental projects can lead to better resource management and conservation efforts, benefiting both sides of the border. This collaborative approach ensures that environmental policies are coherent and mutually reinforcing, leading to more significant and lasting impacts (Knippschild, 2011).

Data management in the context of cross-border cooperation and online platforms is crucial for ensuring effective collaboration and decision-making among diverse stakeholders. Proper data management involves the systematic organization, storage, sharing, and utilization of data across borders, particularly facilitated through online platforms and data hubs. According to research by White (2024)⁷, effective data management frameworks are essential for overcoming barriers related to data fragmentation, privacy concerns, and differing regulatory environments in cross-border cooperation initiatives. These frameworks not only enable seamless data exchange but also promote transparency and accountability among participating entities. The necessity for proper data management in cross-border cooperation is underlined by its role in enhancing the reliability and accuracy of shared information. As highlighted by López-González et al. (2021)⁸, robust data management practices mitigate risks associated with data inconsistencies and facilitate harmonized analysis across international boundaries. Online platforms enable real-time data provision and updates, essential for monitoring progress, evaluating impacts, and making informed policy decisions in cross-border projects (European Commission, 2021)⁹. Institutional mapping in cross-border contexts involves the systematic identification, analysis, and visualization of the various institutions, organizations, and stakeholders involved in governance, decision-making, and service provision across national boundaries (Perkmann, 2003)¹⁰. Firstly, it enhances transparency and clarity by providing a clear depiction of the roles and responsibilities of different institutions operating in cross-border regions (Beck, 2018).¹¹ This clarity is crucial for identifying gaps in governance, potential areas for collaboration, and opportunities to streamline administrative processes. Secondly, institutional mapping supports evidence-based decision-making and policy formulation by providing empirical insights into the governance structures and their impacts on regional development, environmental management, public health, and other critical issues affecting cross-border regions (Scherer, Palazzo, 2009)¹². Furthermore, geographical mapping in INTERREG projects can be used to monitor and evaluate the impact of interventions. By overlaying project data with socio-economic and environmental indicators, project managers can assess the effectiveness of their strategies in real-time and make data-driven decisions to adapt their approaches as needed. For example, an INTERREG project focusing on cross-border environmental management could use geographical mapping to track pollution levels, habitat connectivity, and conservation efforts across the border regions, as highlighted by Scherer and Palazzo (2009).¹³

1.2 Institutional mapping in cross-border cooperation in V4

The growing importance of "institutional mappings" has coincided with contemplation of the dynamics of cross-border

⁷ White, J. (2024) Strategic Data Management: Frameworks, Implementation Challenges, and Success Stories. International

⁸ López-González, J., Casalini, F., Nemoto, T. (2021). Mapping Approaches to cross-border Data Flows. Addressing Impediments to Digital Trade. UK Trade Observatory policy. Centre for Economic Policy Research. ISBN: 978-1-912179-42-8

⁹ European Commission (2021) INTERREG V-A Poland-Slovakia.

¹⁰ Perkmann, M. (2003). Cross-border regions in Europe: significance and drivers of regional cross-border cooperation. European Urban and Regional Studies, 10(2), pp. 153-171.

¹¹ Beck, J. (2018). *Cross-Border Cooperation: Challenges and Perspectives for the Horizontal Dimension of European Integration*. DOI: 10.22394/1726-1139-2018-1-56-62

¹² Scherer, A.G., Palazzo, G. (2009). *Globalization and corporate social responsibility*. In A. Crane, D. Matten, A. McWilliams, J. Moon & D.S. Siegel (Eds.), The Oxford handbook of corporate social responsibility (pp. 413-431). Oxford University Press.

¹³ Scherer, A.G., Palazzo, G. (2009). *Globalization and corporate social responsibility*. In A. Crane, D. Matten, A. McWilliams, J. Moon & D.S. Siegel (Eds.), The Oxford handbook of corporate social responsibility (pp. 413-431). Oxford University Press.

collaboration. Institutional mapping is, in theory, the process of gathering and visualising institutional data from a spatial standpoint. Institutions in this context include both "soft" (like informal networks) and "hard" (like legal restrictions) forms that play a specific de facto role. According to Chilla and Lambracht (2022), institutional mappings can take many different shapes, but they always have these three components: the institutional dimension, which includes information about resources, mandates, and thematic priorities; the spatial dimension, which can include general information about different types of spaces or specific geographical information like perimeters; the technical visualization, which brings together important details in a way that is both highly accessible and "didactic." Furthermore, Chilla and Lambracht (2022) evolved on the applications of institutional mapping to various cross-border cooperation objects have been made. These methods usually include deep analytical insights along with some descriptive data. The subsequent categories pertain to cartographic representations that are geolocalized:

- Diffusion mapping incorporates the governance's time dimension and distinguishes the background role of national players and provide more details on the spatial distribution of the EGTC tool throughout Europe.
- Several mappings centre on cooperation typologies, which classify certain cooperative patterns integrating geographical contexts with the activity statuses of border zones.
- The vertical dimension (between actors on various hierarchical levels) and the horizontal cooperative dynamic (between actors of a similar institutional level) are combined in multi-level governance mapping.
- A visual component of social network analysis could be network mappings by using the example of policy networks in the context of international transportation networks.
- A frequently used technique to depict the areas included in official border regions and cooperation areas is perimeter mapping. Since perimeter maps frequently specify where involved partners must be situated (or active) in order to get funds, eligibility information is crucial in this context.
- Academic comments have used thematic priority mapping on several occasions.

Table 1. Analysing INTERREG projects in V4 from mapping point of view

Types of database project mapping	Description of use in INTERREG	Country programme best practice
Diffusion mapping	Differentiate the role of the national actors as governance	Slovakia Hungary Austria Poland
Diffusion mapping	Graphic part of social network	Slovakia Poland
Thematic priority mapping	Academic reflections	Slovakia Hungary
Cooperation mapping Multi-level governance Perimeter mapping Cooperative areas and legal forms	Cooperative areas and legal forms	Slovakia-Czechia
Multi-level governance	Between actors and institutions	Slovakia -Poland
Perimeter mapping	Eligibility and territory	Slovakia Hungary

Source: own collaboration based on Chillas

Speaking about Network mappings can be the graphic part of social network analyses. In this case study elaborate this for the example of policy networks in the field of cross-border transportation network, labour market and the environmental issues.

Selecting Multi-level governance mapping combines in Slovakia the horizontal cooperation dynamic between actors of a similar institutional level we can experience with the vertical dimension and between actors on different hierarchical levels in the state institutions.

2 Methodology Data Research

This study relies on data from the KEEP database, which serves as a fundamental resource for INTERREG-related research. Managed under the INTERACT initiative, the KEEP database encompasses information on projects, collaboration partners, financial aspects, and thematic areas across various European programs. It is accessible for download as an open-source repository, presenting its contents through tables, diagrams, and maps. Basic institutional mapping capabilities are also available directly through the database (e.g. <https://keep.eu/statistics>). Our research specifically focuses on data from INTERREG V A, excluding information from other programs like INTERACT or ENI, as well as the small project grants under INTERREG. Since the INTERREG IV period, nearly 90% of the data has been consistently complete. All quantitative analyses in this study are based on the KEEP database as of December 2020. However, data availability and quality remain issues of concern. Décoville and Durand (2021, p. 4)¹⁴ critique several limitations, particularly focusing on the thematic categorization of the KEEP database. Consequently, a comprehensive data validation process was necessary to ensure the reliability of findings. The dataset underwent thorough review and updates to rectify typographical errors, missing data, and other identified issues, with specific attention given to aligning postal code classifications. Moreover, certain programs lacked comprehensive information on project partners, offering only basic project details such as lead partner, funding, and budget. The official program priorities assigned in the KEEP database were found to lack complete credibility. In response to these challenges, our analysis commences with already classified asignment and categorization by Chilla and Lambracht (2022)¹⁵, which subsequently in forms the following classification: agriculture with specific focus on agricultural practices and their socio-economic implications; culture encompasses aspects such as the arts, historical heritage; economics and research covers economic activities, skilled labour dynamics; environment addresses green energy initiatives, climate change mitigation, environmental education, and habitat preservation; forestry includes sustainable practices in forestry; governance focuses on exchanges within public administration and institutional networking; health involves rescue services, sports, inclusive practices, and preventive measures; labour market considers aspects like volunteering and societal engagement; transportation encompasses architectural innovations, mobility solutions, and spatial planning strategies; travel includes various modes such as slow travel, green travel, and traditional travel. Based on the aforementioned considerations, we identified Agriculture, the Labor Market, and Environment as the three primary areas of focus concerning Slovakia's neighbouring countries.

3 Data visualisation

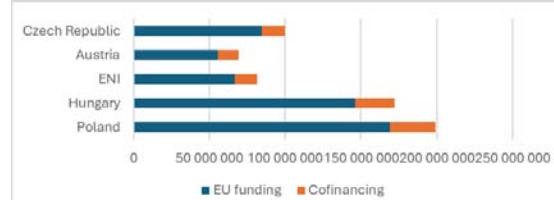
Facilitating evidence-based policy formulation and implementation, Perkmann's (2003)¹⁶ research highlights GIS's pivotal role in mitigating administrative and regulatory barriers among nations. This facilitates enhanced coordination of activities and resource management across borders. GIS achieves this by spatially mapping project activities, assessing environmental impacts, and evaluating socio-economic outcomes, thereby providing valuable insights to stakeholders involved in INTERREG initiatives. There are institutional visualizations presented: a 'thematic programme mapping' and a 'network mapping'. The thematic programme mapping integrates funding amounts and project numbers across different themes, employing a combination of cartographic representations and

spider graphs to depict these dimensions simultaneously. This visualization unveils thematic profiles for each programme area. Since 2000, keep.eu has accumulated extensive data on EU-led territorial cooperation projects, programmes, and partners. Although updates to this page occur once daily, continuous additions are made throughout business hours. This page offers an overview of keep.eu's comprehensive coverage of Interreg programmes, projects, and partners, including the number of projects publishing output papers and those featuring their documents on keep.eu. The foundational data and infographics illustrate keep.eu's overall representativeness. Detailed data exports in Excel encompass every field's representation at both programme-type and programme-level. It's important to note that identifying languages in fields with minimal text poses significant challenges. A comprehensive understanding of keep.eu's data is facilitated by consulting the FAQ section, which covers various topics including data meaning, processes, and concepts specific to keep.eu. The institutional priorities of these programmes are delineated through decisions made during their formulation and implementation stages, exemplified by three key elements. The first element focuses on the program level, emphasizing the overarching framework within which projects operate. Concurrently, the second element delves into project-level dynamics, illustrating the spatial aspects of collaborative networks supported by the programs. Perimeter

4 The case study of Slovakia INTERREG V- A

INTERREG V - A funding for cross-border projects involving Slovakia encompasses five neighbouring countries, as illustrated in Figure 1. This funding includes co-financing and European Regional Development Fund (ERDF) support at a rate of 85%. Poland and Hungary received the highest funding volumes due to the extent of their borders. The European INTERREG V A financing, which incorporates the European Social Fund (ESF), ERDF, and other cohesion funds, reflects this significant financial commitment. It also considers various financing mechanisms, such as co-funding, particularly in terms of national contributions. Programs in countries like the Netherlands and Switzerland notably feature a higher co-funding ratio compared to those in Eastern Europe.

Figure. 1. INTERREG V A Slovakia budget volumes in EUR and the shares of EU- and other funding



Source: KEEP database 2024.

To analyse the length of the borderline and the amounts that can be seen by their linear correlation, the rule is applied that the larger the borderline, the higher the amount of EBRDF granted in terms of Poland. This shows the most extensive amount of the contributions.

The Table 2 provides a summary of the financial grants in the programme period of 2014-2020 in the INTERREG VA programmes of Slovakia's neighbouring countries.

Table 2. Analysing the volumes of INTERREG projects in V4 from financial oint of view

Information	Poland	Hungary	ENI	Austria	Czech Republic
EU Funding	169308291	146460448	665566600	55500000	84731096
Cofinancing	29877935	25845964	1479400	13875002	14952548
Number of projects	53	230	170	50	65
Projects in keep	204	168	78	50	159

¹⁴ Décoville, A., F. Durand. (2021) *An Empirical Approach to Cross-Border Spatial Planning Initiatives in Europe*. Regional Studies 55 (8): 1417–1428. doi:10.1080/00343404.2021.1902492

¹⁵ Chilla, T., Lambracht, M. (2022). *Institutional mapping of cross-border cooperation. INTERREG programme analyses with KEEP data*. European Planning Studies. 31, 1-19. doi: 10.1080/09654313.2022.2058321

¹⁶ Perkmann, M. (2003). *Cross-border regions in Europe: significance and drivers of regional cross-border co-operation*. European Urban and Regional Studies, 10(2), pp. 153-171.

Source: Precise Poland, Hungary, ENI, Austria, Czech Republic budget volumes in EUR and the shares of EU- and other funding KEEP database 2024 and INTERREG websites: www.skhu.at, www.skcz.eu, www.atsk.eu, www.plsk.eu

Table 2 provides an analysis of the volumes of INTERREG projects in V4 countries (Poland, Hungary, Czech Republic) along with ENI and Austria, from financial stand point. Poland has the highest EU funding, significantly surpassing Hungary's, ENI's, Austria's, and the Czech Republic's. Cofinancing follows a similar pattern, with Poland receiving, which is the highest among the listed countries, while the Czech Republic and Hungary follow with 14,952,548 EUR and 25,845,964 EUR, respectively. The number of projects and their representation indicates a higher involvement and financial backing for Poland, reflecting its substantial participation in INTERREG initiatives compared to its V4 counterparts and Austria. The data underscores Poland's leading role in securing and utilising EU funds for regional development projects within the analysed group.

5 Relevance of cooperation

The cooperative programs involved exhibit various differences, which can be understood from multiple perspectives. Broader political, historical, and geographical factors influence these processes. Since their establishment in 1990, INTERREG programs have continuously expanded and broadened their scope. In the specific study areas we are examining, namely, the division between post-socialist countries and non-EU member states, this expansion is notable. Countries lining the western borders are considered "original" INTERREG members, having been involved since the beginning and benefiting from decades of prior cooperative efforts. This characterization applies to Hungary, Slovakia, Czechia, and Poland, all of which were founding members of the EU. Following the dismantling of the Iron Curtain, Poland and the Czechia in the eastern region swiftly became participants in INTERREG programs. Subsequently, through reform processes, there was a significant shift in regional policy strategy. The distinctiveness of these cross-border cooperation efforts is underscored by notable language barriers and substantial institutional differences. The varying stages of maturity across these contexts are elucidated through institutional mappings. The situation differs notably between Switzerland and Austria, particularly due to Austria's accession to the EU in 1995. The evolution of legal frameworks for cross border governance is a relatively recent area of study, despite generally manageable challenges in terms of language and political alignments in cross-border collaboration. Higher project budgets tend to correlate with more advanced collaboration maturity. Cooperation programs involving countries such as Poland, Czechia, and Austria generally allocate smaller project expenditures compared to their counterparts in Western Germany, for example. Funding for projects often mirrors the allocation for broader programs. Moreover, greater cooperation experience tends to foster stronger collaboration frameworks and more sophisticated project management structures. For less experienced participants in INTERREG, engaging in smaller-scale initiatives could be advantageous for gaining valuable experience. While governmental support directly contributes to the establishment of cooperative institutions, domains such as tourism and culture, often viewed as softer topics, are considered suitable arenas for cooperation. Surprisingly, in the western cooperation zones, there is a stronger focus on environmental concerns, economic development, and spatial planning rather than forestry and agriculture. These fields appear to require higher levels of collaborative experience. The institutional mappings outlined above reflect the complex interplay of institutions in multi-level governance environments where INTERREG cooperative dynamics are embedded. Various entities — including national governments, regional agencies, European organizations, and transnational entities — interact within these environments. These interactions fluctuate throughout the policy cycle; during budget negotiations, for instance, the European Parliament and national representatives play significantly larger roles compared

to the implementation phase, which primarily involves lower-tier institutions.

6 Conclusion

The presented study presents the information that cross-border regions exhibit similarities in terms of data and economic and geographical characteristics, aligning with the core objectives of the European Union's cohesion policy, which aims to integrate border regions and reduce disparities. Various tools are used to address these disparities, including the European Territorial Cohesion (ETC) framework. The evolution of border areas has been increasingly studied through institutional mapping methodologies in recent years. These methods visually connect institutional and spatial patterns, enhancing our understanding of cross-border dynamics. Parallel to this, the EU KEEP database has grown significantly in both scope and quality of cooperation-related data. Our study's added value lies in the explicit mapping and analysis of geographical data. The KEEP database is a valuable resource provided by the European Commission, summarising all available data from previous programming periods interactively. The years 2014-2021 are particularly well-represented, providing insights on data utilisation and interpretation of the data from the INTERREG projects. The EU and European Commission intended for this portal to offer policy guidance and strategic recommendations based on statistical analyses, influencing future programming periods and thematic priorities at NUTS 1, NUTS 2, and NUTS 3 levels. In this study, five INTERREG programs neighbouring Slovakia—HU, CZ, AT, PL, and ENI were compared. The analysis revealed that the number of projects and financial allocations increase with the length of the border segment per each country, as exemplified by Poland and Hungary. Smaller segments, like those with Austria and the Czechia, implement projects that are thematically similar but adapted to regional needs. Additionally, our study has two primary objectives. First, we aim to understand the financing regions and cooperation dynamics of the most recent INTERREG A period, using V4, Austria and ENI cross-border initiatives and data tools. The connections between the spatial arrangements of financed project cooperation were analysed, the thematic themes addressed, and the territorial contexts, particularly urbanization levels and border proximity. Second, the pros and cons of institutional mapping using KEEP data were assessed, noting its usefulness for data exploration and comparative studies.

Various functions of the KEEP database were tested. It provides extensive statistics on thematic priorities and the EU's 11 priorities for 2014-2021, which have been consolidated into five strategic priorities. According to predictions from experts in sectoral and territorial assessments, this portal will become increasingly useful, particularly for academics, as not everyone is proficient with GIS or Power BI tools. Given the expansion of regional planning programs, historical data analysis will be increasingly necessary for effective planning and documentation. Institutional mapping utilizing KEEP data can make a substantial contribution, especially in light of the new funding term and the challenges posed by the ongoing pandemic, emphasizing the need for improved analytical insights.

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ONLINE LEARNING PLATFORMS AND THEIR USE FROM THE PERSPECTIVE OF UNIVERSITY STUDENTS

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Abstract: Due to the pandemic situation, many educational institutions are forced to supplement traditional teaching with online activities. The choice of appropriate technical tools, whether in the form of LMS (e.g. Moodle) or communication platforms with the possibility of sharing learning materials (e.g. MS Teams), is largely up to the choice of the respective educational institution. The latter often faces a difficult choice, as the range of such applications and systems on the market is wide and it is not easy to find the most suitable tool to suit all needs. Apart from the technological aspects of each platform, which are described and compared in the paper, the attitudes and opinions of the learners who use these online tools and platforms play an important role. Thus, the present study is also concerned with the attitudes of university students towards online learning as one of the modern forms of education in their undergraduate studies and presents the course and some selected results of a research investigation conducted between 20018 and 2022, where the main objective was to determine the preferences and opinions of students on the form, organization and individual tools or elements of online education. Thus, the present study is a contribution to the discussion on the possibilities and limits of using online education in undergraduate or lifelong learning built on the use of modern information and communication technologies.

Keywords: e-learning, online education, online learning activities, online learning environments

1 Introduction

The continuous development of information and communication technologies has opened up new possibilities for their use in education. Indeed, these technologies can increase the accessibility of education and also offer new means of learning (Zounek, 2009, Klement et al., 2012 and others). Today's pupils and students, for whom the use of digital technologies is a normal part of everyday life, require the integration of these technologies into their learning. There are even views that knowledge and use of digital technologies is considered one of the core competences, similar to reading, writing and numeracy (Cerny, 2019; Ferrari, 2012; and others). Thus, it is undeniable that modern digital technologies cannot be ignored and it is necessary to use their potential also in pedagogical practice. One of the ways in which information technology can be incorporated into the educational process is e-learning. There are a number of definitions of e-learning, which have been developed at different times and often differ significantly due to the continuous dynamic development of e-learning itself and the related information and communication technologies (cf. Korviny, 2005; Kopecký, 2006; Průcha, 2009; Zounek, Sudický, 2012 and others). For this reason, in the following, we will conceptualize e-learning as a process that has several basic components, which we will therefore approach.

The first component of e-learning is the learning content itself, which is represented by comprehensive training courses (e-courses) that can be quite extensive. At a lower level of comprehensiveness, the learning content can also consist of individual learning modules that can be combined to form learning courses. E-courses are usually composed of hypertexts with the subject matter being explained, supplemented by static and dynamic graphics, multimedia content, diagrams used to facilitate the explanation of the problem in the form of graphical communication (Friedmann, 2001).

Another important component is the distribution of education. This is carried out in the case of e-learning and through online in the form of the Internet or intranet, or by means of data carriers (in the case of off-line form of education). Both in the

on-line and off-line form of the course, web standards (XHTML, XML, etc.), security standards and e-course standards used to communicate with the educational system are used for the environment (Barešová, 2011).

The last element of the educational process is educational management. Learning management can be defined as the process that ensures the management of e-courses and students, including the monitoring of their learning outcomes. This process is provided by the educational institution and is mainly managed by learning managers. It provides them with a comprehensive overview of the success of individual learners or study groups and evaluates e-courses. In this way, the effectiveness of the courses and the quality of the individual course modules can be accurately monitored. An indicator is the success rate of students in the post-module tests and in the final course test. On the basis of this information, some modules can be modified or removed from the course altogether and replaced by other modules. Usually there is also a possibility of communication with the human resource management system, which in this way receives accurate information about the success rate of individual students and their abilities (Barešová, 2011).

E-learning, if it is to be a truly effective tool for distance learning, must rely on an appropriate technological base, which in this case is provided by LMS or platforms enabling online learning activities. In the next part of the paper we will therefore deal with these systems and describe in more detail their functions in the educational process and their relation to the individual components of distance learning implemented in the form of e-learning.

2 LMS and online learning platforms and their characteristics

An LMS or online learning platform is a prerequisite for a truly effective e-learning process. The term LMS can be defined as "*Learning Management System - which translates to learning management system*" (Nobilisová, 2010). LMS or online learning platform represents a virtual "learning" environment, which contains tutorials, tests, study instructions, practice plans or discussion forums (Klement, Dostál, 2018).

LMS or online learning platforms are classified as online applications. It is an environment provided through web browsers (browsers), which is created for the purpose of managing educational content, its distribution and control of the educational process. In doing so, it is very often a modular system that allows for customization of use based on the individual ideas of its operator (Eger, 2020). The most widely used modules of LMS and online learning platforms include:

- presentation and creation of educational content,
- tests and surveys,
- file management,
- administration of users and groups (often associated with the school environment as "student", "teacher", "tutor", etc.),
- tasks and calendar,
- communications,
- blogs, articles and up-to-date information.

It should be noted that different sources may differ in this area as well, as the names or concepts of individual modules of LMS or online educational platforms vary according to individual manufacturers and from the perspective of the use of these applications, we can then observe different criteria for the applicability of modules. Some manufacturers of LMS or online learning platforms focus more on the learning process, while others focus mainly on the management of educational content. An important factor influencing the modular arrangement is the circumstance in which area the LMS or online learning platform

is deployed, whether in regional education or in public administration or large educational institutions or enterprises, and what requirements are therefore placed on the system in this respect.

3 LMS and other platforms for the implementation of online learning activities

In view of the poor situation that has arisen in the context of pandemic restrictions, which has affected not only everyday life but also education, many educational institutions have to supplement traditional teaching with online activities. For such teaching to be meaningful, it is not enough to simply assign homework via social networking sites, but a comprehensive technical means must be incorporated into teaching to supplement or replace online learning activities. The choice of the appropriate technical means, whether in the form of an LMS (e.g. Moodle) or online platforms with the possibility of sharing learning materials (e.g. MS Teams), is largely up to the choice of the respective educational institution. The latter is often faced with a difficult choice, as the market offer of such applications and systems is wide and it is not easy to find the most suitable tool to suit all needs.

The most commonly used platforms include the already mentioned LMS Moodle, but also several other products that fully or partially replace its functionality. The implementation of a full-fledged LMS is usually very time-consuming and costly, which is why many smaller educational institutions choose alternative online educational platforms such as MS Teams, EduPage or Google Classroom. It is possible to encounter the approach that online learning activities do not cover the entire portfolio of educational activities of the school, but focus only on selected subjects or activities.

For this reason, in the following sections we describe the main characteristics and features of selected technical solutions currently available on the Czech market. We will also try to compare them and define the main benefits or negatives of each platform in order to facilitate the orientation of future users.

3.1 LMS Moodle

The acronym MOODLE (Modular Object-Oriented Dynamic Learning Environment) suggests that it is a system made up of individual modules, allowing the appropriate design of courses and the entire management of education according to the needs of the institution (see https://docs.moodle.org/311/en/Main_page). The system is bound by the GNU open license, allowing free use. The individual learning courses, which are created directly in the Moodle environment, are catalogued and sorted into hierarchical categories, allowing potential candidates easy orientation and consistent access to course offerings, enrolment and completion.

LMS Moodle can be connected to the existing information systems of the organization, both in the form of batch update scripts and direct user authentication, over existing databases of HR systems. The design of the system can be adapted to the organisation's existing web presence. The concept of uploading and downloading files in Moodle is extended to include repositories and portfolios. Users can upload and download necessary data from repositories (repositories) in the Internet (cloud) space and are not bound to their computer. Of course, access to Moodle is also from a mobile application in addition to the computer.

3.2 EduPage

In addition to the LMS functions, the EduPage platform also includes a school-wide agenda, such as the school register, attendance and class register, timetable, lunch payments and more. The versatility of this platform somewhat reduces the clarity of some of the elements and possible search for information (see <https://help.edupage.org/>).

In terms of working with the tasks and the curriculum, the content is structured into cards that relate to a specific learning unit and its curriculum. Communication on EduPage uses messages and a bulletin board. It is sometimes difficult to find older posts in the messages because they are archived and need to be opened months later. When a news item is posted on the bulletin board, a message is automatically generated to all affected users. The interactive lessons module is useful for distance learning. It consists of a presentation that can be supplemented by questions. Logged-in users can answer them during the lesson and can be evaluated after the lesson. EduPage allows students to work and evaluate in groups within the class.

When it comes to integrating EduPage with other applications, the use of MS Teams is suggested. It is possible to insert a URL link to an online lesson in Zoom or MS Teams. When the user clicks on the link, they are automatically connected to the video conference. EduPage also offers a mobile phone app that makes the entire agenda accessible.

3.3 Microsoft Teams

Teams is not primarily an e-learning but a communication platform. Its potential in distance learning is primarily in face-to-face teaching via videoconferencing. It is possible to set up regularly recurring meetings in the calendar that correspond to classes and subjects in the schedule. Sharing of materials, assignments and testing are features accessible in the individual channels associated with these meetings (see <https://docs.microsoft.com/en-us/microsoftteams/>).

In terms of presenting the curriculum, it is based on PowerPoint presentations or MS Office file sharing, but also allows sharing of notes in OneNote (can be used as a whiteboard in class). The external app makes screen sharing available, but this slows down the transfer. Some users point out that MS Teams adjusts to the transfer speed of the weakest connection in the group, which can lead to degradation in transfer quality. The board that is available only allows raster graphics and without an electronic pen its use is questionable. Task evaluation and testing is done by linking MS Teams with other applications such as Excel and Forms. The linking is automatic but may be somewhat confusing for the teacher.

3.4 Microsoft Teams

Unlike the above platforms, GeoGebra Classroom is more of a one-off activity, but has a wide potential in teaching subjects where the use of mathematical apparatus is essential. GeoGebra can be used for calculations, algebraic equation solving, statistics and working with tables, plotting and displaying in space. All its modules are interactive and allow automatic evaluation using simple scripts (https://wiki.geogebra.org/en/Main_Page).

GeoGebra Classroom is interesting in that the teacher can monitor in real time the performance of the tasks on the previews of all learners, or open an individual applet and test if it works correctly, but does not affect the work of others. GeoGebra is an open-source platform and the materials created on it are freely shared. There are a number of excellent tools for teaching maths, physics and chemistry on geogebra.org. A major drawback of GeoGebra Classroom is the way you log in to the class using a URL link or password. This is because there is no way to verify the identity of the learners, so in theory they can have someone else work for them.

4 Comparison of selected platforms

In this section, we will try to compare the different platforms described above for the implementation of online learning activities and define their main characteristics in terms of their potential applicability for individual learning activities. This comparison will be made in terms of content structuring, possibility of user involvement, structure of learning material, type of tasks and tests, communication possibilities and other related aspects.

The resulting comparison of the different platforms can be seen in Table 1 below, which shows the main features of the selected characteristics.

Table 1: Comparison of selected LMS and other e-learning tools.

	Moodle	EduPage	MS Teams	GeoGebra
content breakdown	odds - format: <ul style="list-style-type: none">• thematic• Chronological• Discussion	the basic unit is determined by the lesson in the timetable	feeds	one hour
users	enrolled only; division into courses and groups	enrolled only; grouping	enrolled only; channel splitting, possibility of splitting into groups when meeting	using the URL link and password, it is not possible to verify the identity of students in the class
teaching materials	<ul style="list-style-type: none">• website or online book• multimedia files• videoconferencing (plugin)• external activities (LTI, SCORM)• lecture (tree zoning, interactive)• downloads• URL links	<ul style="list-style-type: none">• arrangement according to the curriculum:• variable content cards including multimedia• interactive lessons in the form of presentations and questions• downloads• URL links	<ul style="list-style-type: none">• videoconferencing• downloads• URL links• external activities	<ul style="list-style-type: none">• interactive applications
tasks	<ul style="list-style-type: none">• text or file• individual and group• entering comments• special input types from plugins	<ul style="list-style-type: none">• file or text• Comment	<ul style="list-style-type: none">• file or text• detailed breakdown of feedback• Comment	<ul style="list-style-type: none">• tasks in the application• questions• Comment
tests	<ul style="list-style-type: none">• Interactive or without hints• random selection of questions• use of random variables• use of algebra and formulas (plugins)	<ul style="list-style-type: none">• training and evaluation• possibility of variants	<ul style="list-style-type: none">• in an external application, e.g. MS Forms or Google Classroom	<ul style="list-style-type: none">• the possibility to use tasks for evaluation
other content	<ul style="list-style-type: none">• Discussion• dictionaries (activity)• wiki-site• workshops• surveys and more	<ul style="list-style-type: none">• bulletin board• survey	<ul style="list-style-type: none">• sharing work and results via the teacher's screen	<ul style="list-style-type: none">• sharing work and results via the teacher's screen
communications	<ul style="list-style-type: none">• chat• News• discussions and news	<ul style="list-style-type: none">• chat• News• bulletin boards	<ul style="list-style-type: none">• chat• the channel acts as a bulletin board	<ul style="list-style-type: none">•
overviews	<ul style="list-style-type: none">• course fulfilment• overview of activity logs• Calendar	<ul style="list-style-type: none">• overview of task performance	<ul style="list-style-type: none">• statistics using external applications	<ul style="list-style-type: none">• previews of pupils' work• response statistics
note	the course has an adjustable ending (it does not have to end, it does not have to be evaluated, etc.)	the curriculum is valid for the school year, it contains other agendas: attendance, class register, timetable, etc.	automatic linking of applications for individual purposes	one lesson; Lots of ready-made resources; links to Google Classroom

The above comparison of platforms for the implementation of online learning activities is certainly not exhaustive, as it omits some important technical and financial aspects of implementation.

5 Conditions of the research investigation and description of the method

The main objective of the research was to collect and evaluate the opinions and attitudes of students towards learning supported by online learning platforms. This main objective was achieved through the use of individual sub-sections, which were designed to collect students' opinions and attitudes towards the online form of learning as a whole, but also towards individual parts. The individual sub-sections of the research were formalised into questions which formed the basis of a structured anonymous

questionnaire (Foddy, 1994) which students completed according to the instructions provided.

Verification of the stated research assumptions was carried out using the static non-parametric Pearson chi-square method, which was used to determine the dependence of the results on some significant characteristic of the group of respondents, such as gender or age (Greenwood, Nikulin, 2006). Basic descriptive statistics and their visualization using tables were used to determine the power of each group of respondents who answered in the same way. Statistica 14 statistical system was used for the calculation (Nisbet, 2019).

6 Formulation of the main research assumptions and description of the research sample

On the basis of previous personal experience and studying the results of research or surveys conducted in this area, whether domestic or foreign, we have come to the conclusion that the area of online education implemented using online platforms has significant specifics compared to the classical concept, which allow to increase the efficiency of the entire educational process. This is especially the area of psychomotor competences, where information and communication technologies, represented by multimedia extensions or simulations or even virtual reality, allow the creation of such tools, the replacement of which by static elements of the structure of electronic learning support would be very difficult.

The above-mentioned facts led us to formulate research assumptions that would respect the modernization trends in the field of ICT-supported education. We started from the following research assumptions:

- Students are satisfied with online education in the form of, as they are comfortable with a fully electronic learning environment in the form of online learning platforms and this interest is long term.
- Students prefer multimedia elements with an interactive character and this interest is stable.

The research sample (Creswell, 2008) to test the above research assumptions, consisted of a total of 501 first year university students who had completed part of their studies online. The research sample was selected to ensure a proportional representation of males and females, matching the structure of students in other forms of study. An overview of the structure of the research sample can be seen in Table 2 below.

Table 2: Structure of the research sample

Gender	Number of respondents in each year	Total number	Total number in %	Satisfaction with the implementation of online learning in %
Girls	2019 - 40 2020 - 39 2021 - 46 2022 - 56 2023 - 39	220	44 %	94 %
	2019 - 53 2020 - 63 2021 - 59 2022 - 48 2023 - 58			
Boys	281	56 %		

The students had the opportunity to express their opinions and attitudes towards the online teaching using electronic teaching materials. The research questionnaire contained a total of 9 questions, which students answered anonymously.

7 Selected results of a research survey on students' views and attitudes towards online education

The main fact investigated in this part of the research was the students' satisfaction with the arrangement of learning implemented using online learning platforms, where the main form of learning is not full-time teaching, but self-directed

learning (Kluge, Riley, 2018) using suitably prepared electronic learning materials embedded in online learning platforms. A research assumption was established: *students are satisfied with an online learning arrangement in which electronic learning materials are the primary facilitator of learning content and the online learning platform provides the communication, evaluation and management aspects of the learning experience.* This assumption was verified by analyzing the data collected in the questionnaire survey. In addition to the aggregate opinion on the issue, we observed the long-term trend in this area and also analyzed whether or not the students' opinions are dependent on their gender. Table 3 and contingency table 4 present the results of this validation.

After analyzing the obtained results, it can be concluded that *students are satisfied with the organization of online learning if electronic learning materials are the main mediator of educational content and the online learning platform provides communication, evaluation and management aspects of the study*, as a total of 94.2% of respondents answered this question positively and only 5.8% of respondents answered negatively. Furthermore, it can be concluded that *student satisfaction with the online learning arrangement is continuous* and the results are consistent across the years when the research was conducted. The highest observed dissatisfaction of students with the arrangement of online teaching was in 2020 and was 7.8% of respondents, on the other hand, the highest level of student satisfaction with the arrangement of e-learning teaching was in 2019 and was 95.7%. However, both of these observed values are only slightly deviated from the overall observed results (for the dissatisfied respondents it is by 2% and for the satisfied respondents it is even by only 1.5%), and therefore it can be said that the observed results in each year do not differ significantly from each other, and therefore *the trend of development in this area of students' opinions and attitudes is stable and shows neither growth nor decline*. This fact is illustrated in Table 3.

Table 3: Students' satisfaction with the online learning arrangement expressed in percentages

Student satisfaction with the teaching arrangements online as a percentage						
year	2019	2020	2021	2022	2023	Total
dissatisfied in %	4.3	7.8	5.7	5.8	5.2	5.8
satisfied in %	95.7	92.2	94.3	94.2	94.8	94.2

We supported the objectivity of the results by conducting a further analysis to see if this result was dependent on the gender of the respondents. This was verified using a chi-square test and the results are presented in contingency table 4.

Table 4: Satisfaction with the arrangement of online learning by girls vs. boys

Contingency table, cell frequency > 10 is in italics Pearson chi-square: 4.1202, degrees of freedom: 1, significance = 0.0424			
Gender of respondents	I am not satisfied	I am satisfied	Line sums
Girls	18	202	220
Boys	11	270	281
All groups	29	472	501

Since the calculated significance value is 0.04, as shown in Table 4, we can say that *the frequencies of individual responses of boys and girls in terms of their opinions on satisfaction with the arrangement of online teaching are different*, and therefore this evaluation is partly dependent on the gender of the respondents. The obtained result can be interpreted in such a way that the frequency of dissatisfied girls is higher than the frequency of dissatisfied boys.

8 Selected results of a research survey on students' opinions and attitudes towards the content and structure of e-learning materials

Another of the assertions tested in the presented research investigation was the research assumption that *the most*

preferred element of structure in learning implemented through electronic learning materials is the dynamic element in the form of interactive learning animation. With this question we responded to the fact that the classical concept of evaluation of electronic learning materials does not take into account some modern trends in the implementation of online learning using its more modern components, such as e-twinning or virtual reality. These educational strategies, which are mainly based on achieving psychomotor and affective learning goals, are nowadays becoming a major concern for both students and authors or tutors (Lowenthal and Wilson, 2009). Thus, overall, students could choose one of the three options offered: a static element in the form of text, a static element in the form of visual information (images) and a dynamic element in the form of interactive visual information (simulations and animations).

According to the results obtained, the dynamic element in the form of an interactive learning simulation or animation was the best element of the structure of the e-learning material and only in second place was the static element in the form of "written" text, which is a surprising finding, but in line with the research assumption. Overall, then, 43.5% of respondents preferred a dynamic element in the form of interactive simulations or animations as the most appropriate element of the structure, followed by 34% of respondents preferring a static element in the form of text and 22% of respondents preferring a static element in the form of images. Therefore, it can be said that *dynamic elements in the form of interactive learning simulations or animations are the most preferred elements in the structure of e-learning materials, followed by static elements in the form of texts and images.*

On the basis of Table 5, expressing the percentage of students' opinions on the issue under study in each year of the research survey, it can be stated that *the trend of development in this area of students' opinions and attitudes is stable and shows neither growth nor decline.*

Table 5: Students' opinions on the most suitable element of the structure of the e-learning material expressed in percentages

Students' opinions on the most suitable element of the structure of the e-learning material expressed in percentage						
year	2019	2020	2021	2022	2023	diam.
static text information in %	36.6	30.4	37.1	30.8	39.2	34.7
static image information in %	25.8	23.5	21.0	19.2	19.6	21.8
dynamic image information in %	37.6	46.1	41.9	50.0	41.2	43.5

In view of possible differences in the perceptions of boys and girls, we subjected this partial result to a further analysis, namely: *whether there are differences in evaluation between boys and girls.* We verified this claim on the above sample of 501 respondents using a chi-square test. Statistica 14 was used for the calculation and the results are shown in Table 6.

Table 6: Students' opinions on the most appropriate element of the structure of the e-learning material - girls vs. boys

Contingency table, cell frequency > 10 is in italics Pearson chi-square: 0.9986, degrees of freedom: 2, significance = 0.6067				
Gender of respondents	preferred element - text	preferred element - pictures	preferred element - animation	Line sums
Girls	72	47	101	220
Boys	102	62	117	281
All groups	174	109	218	501

Since the calculated significance value is 0.61 as shown in Table 6, based on this value, we can conclude that *the frequencies of the individual responses of boys and girls in terms of their views on the preferred presentation element of the curriculum in teaching implemented using electronic teaching materials are the same, and therefore this evaluation is independent of the gender of the respondents.*

9 Discussion of the results achieved

The idea of a completely natural use of ICT, including e-learning tools and on-line platforms, by today's generation of students, is more or less taken as a fact, based on two major arguments. The first one stems from the fact that today's adolescents and even infants deal with and manage the computer technology with a rather striking spontaneity. The second argument is based on the statistics demonstrating the level of dependence of the use of ICT on age, showing that unlike older generations; nearly all adolescents use the Internet and mobile phones (Lowenthal, Wilson, 2009). It is around these arguments that Don Tapscott American (1998) built his essays claiming that the power model of the family was disturbed, because, unlike the past, children were taking over the teaching role and educated their parents with respect to the orientation in the digital environment. His concepts of N-GEN and that of the digital generation were soon followed by other concepts, i.e. digital natives (Prensky, 2009), homo-zappiens (Veen, Vrakking, 2006), digitally birth (Palfrey, Glasser, 2008) and others. "Digital natives are used to receiving information very quickly. They like doing more activities at a time (i.e. multitasking). They prefer the image processing over the processing of the text. They prefer a random access to information (i.e. hypertext) and they like best working in a networked environment (online). They expect immediate praise and frequent evaluation of their work". (Prensky, 2009). The ideas of Prensky and Tapscott were quite influential at the time and have later become subject to several attempts, more or less successful, by various researchers, to refute them (Bennett, 2017).

Within the framework of such a rapidly evolving field as this one undoubtedly is, it is almost impossible to keep sufficient distance, necessary for the achievement of an 'unbiased assessment', which itself is a prerequisite for a professional discussion supported by facts. It is thus necessary to perceive the above stated findings rather as stimuli for further discussion, resulting in a more responsible and balanced approach to the needs of the students whose studies are, though only partly, implemented through e-learning. Although they actually might not be the digital natives and current problems associated with school systems and the results of their action might have their origin elsewhere, the fact cannot be denied. It is therefore necessary to monitor this area constantly, to regularly analyze and evaluate the attitudes of the students involved in this form of education and to keep trying on searching for the best ways to meet their expectations.

10 Conclusion

It is an undeniable fact that e-learning is becoming more and more widespread in Czech education. Although it plays an important role primarily in distance and combined forms of study at universities, it is also increasingly used in primary and secondary schools. This is to some extent due not only to the current pandemic constraints, but also to the desire of schools to supplement their offer of educational activities. Here, of course, it is not possible to fully replace traditional teaching, but it can become a suitable complement to it. Increasingly, teachers at these school levels are thus learning to recognise the advantages of e-learning, which enable them to improve and innovate their teaching. On the other hand, it is important to realise that educational technology alone will not personally improve teaching. It always depends on the specific situation and on individual teachers how they approach these technologies.

There are many platforms on the market that offer the possibility of sharing learning materials, and the choice of the most suitable one is often at the discretion of the respective educational institution. The latter is often faced with a difficult choice, as the market offer of these applications and systems is wide and it is not easy to find the most suitable tool to suit all needs. For this reason, this overview study was also created to present the main characteristics of the selected platforms for the implementation of online educational activities. We believe that an overall

comparison of these selected platforms can help in the selection and implementation of a specific tool.

Although the above stated results cannot be regarded as significant, they indicate trends that should be taken into consideration by up-to-date education making use of electronic teaching materials texts and on-line platforms. The attitudes of the students could provide us with a guideline helping to find the optimal way towards satisfied, educated and professionally prepared tertiary education graduates and graduates of lifelong learning programmes. The investigation research conducted shed some light on some of the preferences and attitudes of the students related to this field, which can be regarded as long-term. It can therefore help all those who want to design e-learning tools to meet the needs of their students or pupils the best way possible.

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TECHNOSTRESS AMONG CZECH UNIVERSITY STUDENTS: IDENTIFYING AT-RISK GROUPS

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Abstract: This study examines technostress among Czech university students and identifies groups that may be more vulnerable to technology-related strain. A sample of 420 students completed the six-dimension Technostress Scale. Inferential analyses revealed significant differences across several demographic and academic factors. Older students reported higher *Work-Home Conflict* as well as greater *Techno-Reliability* and *Techno-Sociality*, while women showed higher *Techno-Overload* than men. Psychology students reported higher *Techno-Reliability* and *Techno-Sociality* compared with several other fields, and part-time students reported lower *Techno-Reliability* than full-time students. Overall, the findings indicate that technostress varies meaningfully across student subgroups and should be considered when developing support for students' digital well-being.

Keywords: technostress, university students, information communication technologies

1 Introduction

Digital technologies play an increasingly central role in university life and beyond, with their daily use becoming unavoidable in the contemporary world. While these tools offer clear benefits, their intensive and often mandatory use in meeting academic requirements can also produce technology-related strain resulting from difficulties in adapting to technological demands. This strain is captured by the concept of technostress, which reflects the dynamic interplay between users and their digital environment and encompasses factors that may both diminish and support digital well-being. Understanding how different groups of students navigate this digital environment is therefore essential, especially as higher education continues to deepen its reliance on digital platforms. Such insights can inform the development of tailored support strategies aimed at promoting students' digital well-being.

2 Technostress

2.1 Definition of technostress

Technostress refers to stress arising from the prolonged use of information and communication technologies (ICT). The term was first introduced by Craig Brod (1984) to describe the negative consequences of the technological revolution for human health. In this paper, we draw on the following general definition: "Technostress is a negative psychological state resulting from an inability to cope with new or changing technologies in a healthy manner" (Brod, 1984). This definition aligns with the transactional model of stress and coping proposed by Lazarus and Folkman (1984), who conceptualized stress as a dynamic interaction between the individual and the environment. Stress occurs when people perceive situational demands as exceeding their capacity to manage them. From this perspective, reactions to technostress depend on how individuals appraise technology-related demands and the coping strategies they employ.

2.2 Technostress and its dimensions

Technostress is a multidimensional construct, with each dimension contributing to psychological strain in a distinct way. In this paper, we draw on the six validated dimensions proposed by Galvin et al. (2022), who demonstrated their relevance for understanding how ICT use influences mental health. The first dimension, *Techno-Overload*, refers to situations in which technology creates excessive informational and task demands. Moore (2000) showed that such overload is a significant risk factor for stress and burnout among IT employees. A second dimension, *Work-Home Conflict*, captures tensions that arise when professional responsibilities intrude into personal life and

vice versa. According to Kreiner (2006), technology can either facilitate or complicate transitions between these roles. Both dimensions have been linked to heightened anxiety and depressive symptoms when not effectively managed (Galvin et al., 2022). The third dimension, *Techno-Ease*, concerns the perceived ease of using digital tools. When technology feels intuitive, it tends to enhance performance and reduce ICT-related stress. Moore and Benbasat (1991) demonstrated that perceived usability shapes technology adoption, while Galvin et al. (2022) found that students who feel competent with ICT report fewer symptoms of anxiety and depression. A fourth dimension, *Techno-Reliability*, focuses on the stability and dependability of technological systems. DeLone and McLean (2003) showed that reliable ICT infrastructure increases productivity and reduces stress by allowing users to trust that essential tools will function consistently. The fifth dimension, *Techno-Sociality*, addresses how technologies shape social interactions. ICT can enhance feelings of connectedness but may also create isolation or interpersonal strain, as Ayyagari (2011) found that technology can simultaneously facilitate communication and introduce new forms of social pressure. The sixth dimension, *Pace of Change*, reflects how individuals perceive the speed of technological development. Rapid technological shifts can cause frustration and uncertainty, particularly when organizations fail to provide adequate support or training. Weiss and Heide (1993) argued that fast-paced innovation can leave users feeling unprepared and overburdened. Together, these six dimensions underscore the multifaceted nature of technostress and illustrate how ICT may serve both as a vulnerability factor and a potential source of support for psychological well-being.

2.3 Technostress among university students

Technostress among university students can be shaped by several contextual and individual factors. One important source is the influence of distance learning. The combination of online instruction and study-family conflict can markedly increase technostress, as students often experience Techno-Overload due to constant ICT demands. Cataldo et al. (2023) showed that such overload during remote education reduces satisfaction with university life and negatively affects academic performance. Another important explanation is offered by the Person-Environment Misfit perspective. Wang et al. (2020) demonstrated that technostress does not arise solely from technology itself but primarily from mismatches between students' characteristics and the environments in which ICT is used. The Person-Environment Misfit model includes three types of misfit. Person-Organization (P-O) misfit occurs when institutional expectations regarding technology use (e.g., e-learning platforms, online testing) exceed students' abilities or resources. Person-Technology-Enhanced Learning (P-TEL) misfit refers to strain caused by students' direct interaction with technology, such as insufficient digital skills. Person-People (P-P) misfit captures the lack of social support from peers or instructors, which can heighten ICT-related stress. Research shows that all three misfit types significantly predict burnout, with P-O misfit—reflecting institutional ICT demands—emerging as the strongest predictor.

3 The present study

The aim of this paper is to identify which groups of university students in the Czech Republic are most affected by technostress. The study examines its associations with key demographic factors (age, gender) and academic characteristics, including study mode (full-time/part-time), international student status, field of study (six disciplinary categories), and type of study program (bachelor's, master's, doctoral). The main research question for this study was defined as follows:

RQ: What is the level of technostress across different groups of university students?

4 Method

4.1 Participants

The research sample comprised 420 students enrolled at higher education institutions in the Czech Republic (M age = 22.8 years, range 18–61), of whom 75.8% were women and 24.2% were men. Participants were recruited from eight universities: the University of South Bohemia, Masaryk University, Charles University, Czech Technical University in Prague, Palacký University, Czech University of Life Sciences, Technical University of Ostrava, and the University of Veterinary Sciences Brno. With respect to study program, 63.4% were enrolled in bachelor's studies, 31.1% in master's studies, and 5.5% in doctoral studies. International students made up 6.4% of the sample, and most participants studied full-time (85.6%). Fields of study were relatively evenly represented, with the largest proportion in STEM disciplines (26.4%), followed by psychology (21.6%), humanities (19%), economics (19%), education (10.8%), and health-related fields (3.1%).

4.2 Procedure

Data collection was conducted online using the Qualtrics platform. Participants were recruited through institutional email communication and supplementary channels, including social media. All participants provided informed consent prior to taking part in the study. Data were gathered between March and December 2022 using a non-probability sampling strategy.

4.3 Measures

The study employed the six-dimension Technostress Scale validated by Galvin et al. (2022). The dimensions were derived from prior conceptualizations: Techno-Overload (Moore, 2000), Work–Home Conflict (Kreiner, 2006), Techno-Ease (Moore & Benbasat, 1991), Techno-Reliability (DeLone & McLean, 2003), Techno-Sociality (Ayyagari, 2011), and Pace of Change (Weiss & Heide, 1993). The instrument comprises 17 items rated on a seven-point Likert scale, with three items per dimension except Techno-Sociality, which contains two. Internal consistency was satisfactory to excellent across subscales: Techno-Overload ($\alpha = 0.830$), Work–Home Conflict ($\alpha = 0.806$), Techno-Ease ($\alpha = 0.846$), Techno-Reliability ($\alpha = 0.821$), Techno-Sociality ($\alpha = 0.780$), and Pace of Change ($\alpha = 0.883$).

4.4 Statistical analyses

To address the research question, differences in the six technostress dimensions were examined across student groups defined by gender, age, study mode, field of study, study program, and international status. As visual inspection and the Shapiro–Wilk test indicated significant deviations from normality for all scales, nonparametric statistical methods were applied. In total, 36 tests were conducted, selected according to variable type: Spearman's correlation (age), Mann–Whitney U tests (gender, study mode, international status), and Kruskal–Wallis tests (field of study, study program). Statistical significance was evaluated at $\alpha = 0.05$, as adjusting the threshold for multiple testing would have been overly conservative. Data were processed using Jamovi statistical software.

5 Results

Across the six dimensions, the highest mean score was observed for Techno-Ease ($M = 16.14$, $SD = 3.35$), followed by Techno-Reliability ($M = 14.16$, $SD = 3.33$). Moderate values were recorded for Techno-Sociality ($M = 11.72$, $SD = 2.31$) and Pace of Change ($M = 11.65$, $SD = 4.21$). The lowest mean scores appeared for Work–Home Conflict ($M = 10.49$, $SD = 4.64$) and Techno-Overload ($M = 10.26$, $SD = 4.50$). Regarding differences among student groups, statistically significant effects were identified for the dimensions Techno-Overload, Work–Home Conflict, Techno-Reliability, and Techno-Sociality. Differences were non-significant for the remaining scales. The results are reported in Table 1.

Table 1: Results of Statistical Tests for Technostress Dimensions Across Student Groups

Scale	Age	Gender	Study mode	Intern. student	Field of study	Study progr.
T-O	-0.011 (0.817)	11342 (0.001)	9639 (0.214)	4050 (0.235)	6.62 (0.251)	0.95 (0.622)
W-HC	0.122 (0.013)	14375 (0.203)	10691 (0.983)	4909 (0.528)	5.49 (0.359)	9.14 (0.010)
PC	-0.006 (0.897)	15193 (0.625)	10095 (0.475)	4896 (0.514)	6.77 (0.239)	2.68 (0.262)
T-R	0.106 (0.030)	14999 (0.499)	8754 (0.030)	5168 (0.838)	16.50 (0.006)	3.95 (0.139)
T-S	0.113 (0.021)	15681 (0.985)	9506 (0.154)	5008 (0.634)	12.50 (0.028)	2.84 (0.242)
T-E	0.027 (0.581)	14466 (0.234)	9844 (0.314)	5008 (0.634)	5.07 (0.408)	0.02 (0.989)

Note. Values represent test statistics with corresponding p -values in parentheses. For age, Spearman's rank correlation coefficients (ρ) are reported. For gender, study mode, and international student status, Mann–Whitney U statistics are reported. For field of study and study program, Kruskal–Wallis χ^2 statistics are reported. T-O = Techno-Overload; W-HC = Work–Home Conflict; PC = Pace of Change; T-R = Techno-Reliability; T-S = Techno-Sociality; T-E = Techno-Ease.

5.1 Techno-Overload

The most pronounced difference emerged in the Techno-Overload dimension with respect to gender. Women ($M = 10.73$, $SD = 4.38$) reported significantly higher levels of Techno-Overload compared with men ($M = 8.68$, $SD = 4.51$), and this effect was statistically significant ($U = 11342$, $p < 0.001$).

5.2 Work–Home Conflict

Within the Work–Home Conflict dimension, significant differences were found for age and study program. Age showed a weak but significant positive association with Work–Home Conflict ($\rho = 0.122$, $p = 0.013$), indicating a slight increase in perceived conflict with increasing age. Study program was also significant ($\chi^2(2) = 9.14$, $p = 0.010$), with doctoral students reporting the highest scores, followed by master's students, and bachelor's students the lowest. Post hoc analysis (Dwass–Steel–Critchlow–Fligner; DSCF) indicated that only the comparison between doctoral and bachelor's students reached significance ($p = 0.016$).

5.3 Techno-Reliability

The Techno-Reliability dimension showed significant differences across three variables. Age was positively associated with perceived reliability ($\rho = 0.106$, $p = 0.030$), indicating that older students viewed technologies as slightly more dependable. Study mode also showed a significant effect ($U = 8754$, $p = 0.023$), with part-time students reporting lower reliability scores than full-time students. Field of study further differentiated students' perceptions ($\chi^2(5) = 16.5$, $p = 0.006$). Psychology students reported the highest mean score ($M = 15.3$), followed by those in health-related fields ($M = 14.7$), while other disciplines ranged between $M = 13.7$ and $M = 14.0$. Post hoc DSCF tests showed significant differences between psychology students and students in economics ($p = 0.008$), STEM ($p = 0.019$), and the humanities ($p = 0.017$). No other pairwise differences reached significance. The mean values across fields of study are presented in Table 2.

Table 2: Means and Standard Deviations for Techno-Reliability and Techno-Sociality Across Fields of Study

Field of study	<i>n</i>	Techno-Reliability		Techno-Sociality	
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Economics	79	13.7	3.14	11.1	2.54
Education	45	14.00	3.00	12.1	1.95
Psychology	90	15.3	3.13	12.3	1.73
STEM	110	13.8	3.50	11.6	2.57
Humanities	79	13.9	3.28	11.4	2.46
Health	13	14.7	4.21	12.6	1.19

5.4 Techno-Sociality

For this dimension, significant associations were identified with age ($\rho = 0.113$, $p = 0.021$) and field of study ($\chi^2(5) = 12.5$, $p = 0.028$). Post hoc analysis (DSCF) showed a single significant pairwise difference: psychology students reported higher Techno-Sociality scores than students in economics ($p = 0.028$). The mean values across fields of study are presented in Table 2.

6 Discussion

The results of this study suggest that technostress is a meaningful and measurable construct among university students in the Czech Republic. Dimensions generally regarded as protective in the context of technology use (Techno-Ease, Techno-Reliability, Techno-Sociality) showed higher mean scores, whereas dimensions associated with greater psychological risk (Pace of Change, Work–Home Conflict, Techno-Overload) were rated lower. Significant differences across student groups further enabled the identification of subgroups that appear more vulnerable, as well as those potentially less affected by technostress. Age emerged as one of the most consistent correlates of technostress. Older students reported higher scores in Work–Home Conflict, Techno-Reliability, and Techno-Sociality. This pattern aligns broadly with findings by Upadhyay and Vrinda (2021), who observed elevated technostress levels among students aged 23–28 compared with younger cohorts. However, the interpretation differs across dimensions. Higher scores in Techno-Reliability and Techno-Sociality likely reflect more positive or confident engagement with technology—such as greater trust in its functionality and more frequent technology-supported social interaction—rather than increased strain. In contrast, the meaning of Work–Home Conflict is more straightforward: this dimension captures the extent to which technology blurs boundaries between study-related demands and personal life. Older students, who are more likely to have additional responsibilities such as employment or caregiving, may experience greater difficulty maintaining these boundaries. This interpretation is further supported by the significant association between Work–Home Conflict and study program, with doctoral students reporting the highest conflict levels. Given that average age increases across study levels, higher scores among doctoral students likely reflect the cumulative effect of age, role complexity, and competing obligations that must be balanced alongside academic tasks. Study mode also emerged as a relevant factor. Part-time students reported lower scores on Techno-Reliability, which may be attributable to their reduced day-to-day engagement with university technologies. Less frequent exposure to institutional platforms and digital tools may limit opportunities to develop familiarity and trust in their functionality, resulting in lower perceived reliability. Field of study showed significant associations with several technostress dimensions, particularly Techno-Reliability and Techno-Sociality. Students in psychology and health-related disciplines reported the highest scores in both dimensions, suggesting a more adaptive integration of technology into their everyday routines. This pattern may also reflect broader psychosocial resources: higher perceived reliability of technology and greater use of digital tools for social interaction can indicate more effective coping strategies and stronger overall well-being. Such tendencies have been repeatedly documented among students in medicine and related health disciplines (e.g., Erekson et al., 2022; Mašková, 2023), who often demonstrate better mental health and more adaptive responses to academic demands. It is therefore plausible that these adaptive approaches extend to technology-related demands as well.

The findings underscore the need for universities to actively address technostress as digitalization becomes increasingly central to academic life. Strengthening students' digital competencies—particularly in areas associated with higher technostress—should be a priority. Practical steps may include targeted workshops on efficient use of study technologies, digital organization, and strategies for maintaining healthy boundaries between academic and personal life. Such initiatives could help

mitigate the negative effects of technological overload while simultaneously reinforcing protective factors that support students' well-being.

This study has several limitations that should be considered when interpreting the findings. Its cross-sectional design precludes causal inferences, and the use of purposive sampling limits the generalizability of the results to the wider student population. In addition, *p*-values for multiple tests were not adjusted, increasing the risk of Type I error. The sample was also unevenly distributed across study groups: bachelor's and full-time students were strongly overrepresented, whereas doctoral and part-time students were included only marginally. This imbalance may have influenced the subgroup analyses. Therefore, the findings should be viewed as preliminary, and future research should aim to replicate them using a more balanced and representative sample.

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THE DEVELOPMENT OF THE INDUSTRY 4.0 CONCEPT IN SOUTH-EASTERN POLAND. THE PERSPECTIVE OF NON-GOVERNMENTAL ORGANIZATIONS AND LOCAL GOVERNMENTS

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Abstract: The concept of Industry 4.0 was formalized in Germany in 2011. It encompasses comprehensive changes in digital production, network communication, information technology, automation, and other areas of business activity. The process of technological transformation is not limited to the manufacturing sector, but is gradually spreading to public administration and non-governmental organizations. The aim of this article is to present the results of empirical research conducted among 68 representatives of local government and 44 representatives of non-governmental organizations from south-eastern Poland. The results obtained allow us to determine the level of knowledge and awareness of representatives of local government units and non-governmental organizations with regard to the technological transformation processes taking place within the Industry 4.0 concept.

Keywords: Poland; Industry 4.0; technological changes; non-governmental organizations; local government, peripheral areas

1 Introduction

Technological changes have always shaped the manner and structure of production processes in the industrial sector, while also having a significant impact on the functioning of public administration and the non-governmental sector. Many technological and organizational solutions that were created for the needs of business organizations have been implemented in the sphere of public administration and the non-governmental sector (see, for example, McAdam et al. 2005; Landry et al. 2013; Rochon et al. 2010; Bendul et al. 2015; Pandey et al. 2022). Groundbreaking technological changes in the literature on the subject are referred to as industrial revolutions (for more details, see, among others, Chalvantharan, 2023; Eason et al. 1955; Moloi, Marwala, 2020). In recent years, the global economy has been implementing a concept called "Industry 4.0," which is also referred to as the fourth wave of the industrial revolution. This revolution is intended to change the way industry operates in terms of technology through digitization. However, the assumptions and effects of "Industry 4.0" affect not only production processes in the business sector, but also extend more broadly to the functioning of the public and non-governmental sectors.

The concept of "Industry 4.0" was formulated in Germany as early as 2011 and was an attempt by the German government to respond to the negative effects of the economic crisis. The term Industry 4.0 first appeared in an article published in November 2011 by the German government, which resulted from an initiative concerning the high-tech strategy for 2020 (Ślusarczyk, 2019, p. 4). Currently, the term "Industry 4.0," referring to the fourth wave of the industrial revolution, has come to describe the digital transformation of the manufacturing process. There are many definitions of the Industry 4.0 concept in scientific literature, one of which, by H. Lasi, states that "Industry 4.0 describes the increasing digitization and automation of the manufacturing environment, as well as the creation of digital value chains to enable communication between products, the environment, and business partners" (Lasi et al., 2014, pp. 239-242). Thus, this paradigm of industrial change covers digital production, network communication, computer technologies, and automation, but also many other areas of activity of companies

and public administration entities (see also, among others, Kiełtyka, Charciarek 2019).

The Industry 4.0 concept is based on the assumption of implementing digital technologies and automating manufacturing processes. The technologies used in the Industry 4.0 concept include, among others, technologies such as: Internet of Things, IoT; Big Data; Artificial Intelligence; Robotic Process Automation; Cloud computing; Virtual Reality; Additive Manufacturing (for more details, see Kaczmar-Kolny, Pośpiech 2023; Gajdzik, Grabowska 2018; Różanowski 2007; Szajna et al. 2018).

All these assumptions concerning the Industry 4.0 concept have been described in the literature on the subject (cf. e.g. Gajdzik and Grabowska 2018; Szum and Magruk 2019). However, the greatest weakness of these publications is the fact that they usually refer to the national or regional level, completely ignoring the conditions of the Industry 4.0 concept at the local level (county, municipality). Such analyses and studies at the local level may be of particular importance in the case of peripheral areas, distant from large urban agglomerations and industrial clusters. Undoubtedly, such areas also include the studied area of south-eastern Poland (cf. e.g. Kaczmarski and Frączek 2021; see also Wilkin 2003, Demaniuk and Szymańska 2016, Idczak 2013). There are many companies in the studied area that manufacture various products, often recognized nationally and internationally. Despite this, the area is characterized by a relatively low rate of economic development, and the Podkarpacie region itself ranks low in terms of industrial innovation. A barrier to the development of entrepreneurship in south-eastern Poland may be the lack of knowledge among local entrepreneurs, local government representatives, and non-governmental organizations about the need to modernize companies and public administration as part of the fourth industrial revolution.

2 Materials and Methods

In order to analyze the level of knowledge and awareness of local government and non-governmental sector representatives regarding the technological transformation processes taking place within the framework of the "Industry 4.0" concept, a survey was conducted in 2025. The survey was conducted in four counties: Brzozów, Sanok, Lesko, and Bieszczady, located in south-eastern Poland. Due to their economic and social conditions, these counties can be considered peripheral areas. The research was funded by the Ministry of Science and Higher Education as part of the Science for Society II program. The study covered 112 representatives of local governments and non-governmental organizations, and the research tool was an extensive questionnaire containing 36 questions. The collected material was analyzed using IBM SPSS Statistics 29. The main objective of the research was to determine the level of knowledge and awareness of representatives of local governments and non-governmental organizations with regard to the technological transformation processes taking place within the framework of the Industry 4.0 concept. The research was also intended to identify the main barriers and determinants in the digital transformation of local governments and non-governmental organizations in peripheral areas, as perceived by the respondents, and to determine the relationships between individual variables.

3 Results of the study

The respondents participating in the survey were mainly women aged 40-49.

Tab. 1: Gender and age of respondents

Gender of the respondent	Number of respondents	Percentage
Female	79	71
Male	33	29
Final total	112	100
Age	Number of respondents	Percentage
up to 29 years old	12	11
30-39	24	21
40-49	45	40
50-59	20	18
60 years and older	11	10
Final total	112	100

Source: Own study

The vast majority of respondents had higher education (91 people, i.e., 81% of the total) and many years of work experience - over 20 years (48 people, i.e., 43% of the total).

The surveyed representatives of local governments and non-governmental organizations often worked as administrative employees (43 people, i.e., 38% of the total), but also often held managerial positions (37 people, i.e., 33% of the total) or expert positions (29 people, i.e., 26% of the total). This structure of the respondents' education, their length of service, and the positions they held may indirectly indicate that the representatives of local governments and non-governmental organizations surveyed should be aware of the importance of the technological changes currently taking place in production processes, but also in the public and non-governmental sectors. The majority of the survey respondents represented local governments (68 people, i.e., 61% of the total), while 44 respondents (39% of the total) represented the non-governmental sector.

In the case of local governments, most were entities employing between 50 and 249 employees (48 respondents, i.e., 42% of the total), while in the case of the NGO sector, most organizations employed between 10 and 49 employees (20% of the total number of respondents). The situation was similar in terms of revenue, with local governments having greater financial resources and the budgets of non-governmental organizations being relatively small. This means that in the case of the NGO sector, the implementation of digital revolution solutions may be significantly hampered due to the scale of revenue. On the other hand, local governments can more effectively implement technologies related to "Industry 4.0" in the functioning of public administration.

The type of activity carried out by the entities surveyed is presented in the table below.

Tab. 2: Type of activity among the surveyed local governments and non-governmental organizations

Type of activity Statistics Poland – by SECTIONS AND DIVISIONS	Number of entities	Percentage
Section A. Agriculture, forestry, hunting, and fishing	1	1
Section C. Manufacturing	3	3
Section D. Electricity, gas, steam, hot water, and air conditioning supply	2	2
Section F. Construction	1	1
Section H. Transport and storage	1	1
Section I. Accommodation and food service activities	1	1
Section J. Information and communication	1	1
Section K. Financial and insurance activities	1	1
Section M. Professional, scientific, and technical activities	3	3

Section N. Administrative and support service activities	4	4
Section O. Public administration and national defense; compulsory social security	54	48
Section P. Education	6	5
Section Q. Health care and social assistance	10	9
Section R. Cultural, entertainment, and recreational activities	10	9
Section S. Other service activities	13	12
Section U. Extraterritorial organizations and bodies	1	1%
Final total	112	100

Source: Own study

The entities surveyed were mainly involved in public administration (54 entities, i.e. 48% of the total), and to a lesser extent, mainly NGOs, service activities (13 entities, i.e., 12% of the total) and activities in the field of health care and social assistance (10 entities, i.e., 9% of the total).

During the research, it was established that the vast majority of local representatives of local governments and non-governmental organizations are not familiar with the term "Industry 4.0." (70 people, i.e., 63% of all respondents). This means that this lack of knowledge about the changes brought about by the digital revolution () may be a significant barrier to technological change in peripheral areas of Poland.

The most well-known technologies related to the concept of "Industry 4.0" among respondents were: Big Data and AI (142 responses, i.e., 16% of the total; number of responses/ number of respondents, multiple-choice question) and Cybersecurity (141 responses, i.e., 15% of the total; number of responses/ number of respondents, multiple-choice question). At the same time, only 22 respondents (20% of the total) indicated that the concept of "Industry 4.0" is a very important issue and will certainly have a significant impact on industry, public administration, and the surrounding reality in the future.

The survey also identified which competencies will be most important in the future in the opinion of respondents.

Tab. 3: The most important competencies of the future for employees in the opinion of respondents

The most important skills of the future for employees in the opinion of respondents	Number of responses	Percentage
cognitive skills	32	29
social skills	38	34
technical skills	42	38
Final total	112	100

Source: Own study

The respondents indicated that technical skills will be the most important in the future (proficiency in the use of new media, information overload management, ability to integrate robotic workstations, ability to work on the human-machine line, programming; 42 people, i.e. 38% of the total).

During the research, it was not possible to clearly determine whether, in the opinion of the respondents, the main barriers to the implementation of various solutions related to the "Industry 4.0" concept in peripheral areas were different from those in central areas (*Yes - the main barriers to Industry 4.0 in peripheral areas are different from those in central areas: 50 responses, i.e., 45% of the total; I have no opinion on this: 55 responses, i.e., 49% of the total; No - the main barriers to Industry 4.0 in peripheral areas are different from those in central areas: 7 responses, i.e., 6% of the total*).

Many authors conducting research on the concept of "Industry 4.0" have pointed out that the high financial costs of implementing these solutions may be a barrier to digitization and technological progress.

Tab. 4: Main barriers to the development of Industry 4.0 in peripheral areas in the opinion of respondents

Barriers	Number of responses*
Inadequate technological infrastructure	140
Limited availability of skilled labor	178
Low level of investment	195
Low technological awareness	144
Poor cooperation between companies and research institutions	142
Problems with the integration of production systems	83
Logistical constraints	123
Lack of an ecosystem supporting innovation	127
Lack of appropriate local regulations	147
Fear of change and job losses	133

Note: *The number of responses does not equal the number of respondents, as the question was multiple choice.

Source: Own study

Similar opinions were also expressed by employees of local governments and non-governmental organizations. The biggest barriers to digital transformation in peripheral areas were: low level of investment, e.g., high implementation costs (195 responses), limited availability of skilled labor (178 responses), low technological awareness, e.g., lack of knowledge about the benefits of implementing "Industry 4.0" (144 responses), and poor cooperation between companies/organizations and research institutions.

A worrying fact that was established during field research was the lack of interest among representatives of local governments and NGOs in the digital transformation of their own organizations.

Tab. 5: Stage of digital transformation of respondents' organizations

Stage of transformation	Number of responses	Percentage
We are at the beginning of the transformation	24	21
We are at an advanced stage of transformation	2	2
We are in the process of developing our transformation	23	21
We use digital technology on a daily basis in almost every aspect of the organization's operations.	13	12
We are not planning a transformation.	50	45
Final total	112	100

Source: Own study

Almost half (i.e., 50 people) of respondents said they do not plan to digitally transform their organizations, and 24 people (21% of the total) indicated that they are currently at the beginning of their digital transformation. Only 2 respondents (2% of the total) indicated that they are currently at an advanced stage of transformation. This means that without an external system supporting the technological transformation of local governments and non-governmental organizations, e.g., through financial incentives, local entities may not participate in the digital transformation and modernization of their own organizations. The main barriers to the introduction of the "Industry 4.0" concept in the surveyed organizations were: budget constraints (74 responses; number of responses ≠ number of respondents, multiple-choice question) and employee resistance to change (37 responses; number of responses ≠ number of respondents, multiple-choice question). At the same time, respondents who participate in the technological transformation of their own entities indicated cost reduction (31 responses; number of responses ≠ number of respondents, multiple-choice question), improved communication (23 responses; number of responses ≠ number of respondents, multiple-choice question), and automation of repetitive tasks (26

responses, number of responses ≠ number of respondents, multiple-choice question).

On the other hand, the factors that, in the respondents' opinion, may determine the implementation of digital technologies within the framework of the "Industry 4.0" concept in peripheral areas were: access to capital, e.g., external financial support (172 responses; number of responses ≠ number of respondents, multiple-choice question); human capital and education, e.g., access to a skilled workforce and education at the local level (171 responses, number of responses ≠ number of respondents, multiple-choice question); and local awareness, e.g., readiness for change (169 responses, number of responses ≠ number of respondents, multiple-choice question).

During the analyses, an attempt was also made to determine the statistical relationships between variables that may influence the implementation of the "Industry 4.0" concept in peripheral areas in south-eastern Poland.

Analyses were carried out to check whether variables such as the gender of the respondent influence their knowledge of the concept of "Industry 4.0." A Chi-square test analysis for local governments indicated that there is a statistically significant relationship between gender and familiarity with the concept of "Industry 4.0" ($\chi^2 = 4.685$; $p=0.030$; Cramér's $V = 0.262$). This relationship is not very significant, as indicated by the value of Cramér's V . In the case of non-governmental entities, no statistically significant relationship between these variables was found ($\chi^2 = 3.750$; $p=0.053$). During the analyses, an attempt was also made to determine whether factors such as age, education, position, and the location of the entity from which the respondent came were statistically related to the variable "knowledge of the concept of Industry 4.0." Unfortunately, in the case of both local governments and NGOs, there were no statistically significant relationships between these variables.

A check was also made to see whether there were statistically significant correlations between the variable "importance of the Industry 4.0 concept to the respondent" and variables such as gender, education, position held, location of the entity from which the respondent came, and the respondent's knowledge of the concept of "Industry 4.0." The Chi-square test analysis showed that there are no statistically significant relationships between these variables.

4 Conclusion

An analysis of the available literature indicates that the concept of "Industry 4.0" in peripheral areas is still important and requires further scientific exploration. The significance of this concept should not be limited to the manufacturing sector, as "digital changes" will also be relevant to sectors related to public administration and non-governmental organizations.

The representatives of local governments and non-governmental organizations participating in the surveys were mainly women aged 40-49, with a high level of education and long work experience. As a rule, these people worked as administrative employees, but they also often held managerial or expert positions. The vast majority of respondents represented local governments. A worrying finding was that most of the people participating in the survey were unfamiliar with the term "Industry 4.0," which may be the first barrier to the implementation of "digital revolution" solutions in peripheral areas of Poland. The awareness of local government representatives and non-governmental organizations about the importance of technological solutions within the concept of "Industry 4.0" may also be worrying. Only 20% of all respondents indicated that these changes will have a significant impact on industry, public administration, and reality in the future. The biggest barriers to digital transformation in local government administration and NGOs in peripheral areas are high implementation costs, limited access to a skilled workforce, low technological awareness (e.g., lack of knowledge about the benefits of digital transformation), and poor cooperation between these entities and research institutions.

Another worrying finding was the lack of interest among representatives of local governments and NGOs in the digital transformation of their own organizations and the fact that these organizations are only at the initial stage of this transformation or do not plan to undertake it at all. This means that without an external (supra-local) system supporting digital transformation, e.g., through financial incentives, local governments or non-governmental organizations may not participate in the digital transformation and modernization of their own organizations or may delay this process. Furthermore, in peripheral areas, it is necessary to have a local system in place to support innovation and cooperation between public administration and the non-governmental sector with the scientific sector. Empirical research indicates that in peripheral areas, the knowledge of public administration and NGO employees about the concept of "Industry 4.0" and their attitude towards digital transformation may be a barrier to the socio-economic development of peripheral areas in Poland.

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Primary Paper Section: A

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POSSIBLE DECONTAMINATION AFTER A TERRORIST ATTACK ON A NUCLEAR POWER PLANT

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Abstract: This paper focuses on analyzing the potential for decontamination following a terrorist attack on the Temelín Nuclear Power Plant. The assessment of current decontamination procedures was conducted using qualitative research methods, specifically through interviews with professionally qualified personnel. The interviews were carried out at the Temelín Nuclear Power Plant and involved selected staff from the Radiation Protection Department and members of the plant's Fire and Rescue Service. The aim of this paper is to evaluate the current state of preparedness.

Keywords: contamination, decontamination, ionizing radiation, radiation emergency, radiation protection, terrorist attacks.

Introduction

The safety of nuclear power plants is a key element of energy stability and national security in the Czech Republic. In view of developments in the international situation and the increasing threat of terrorism targeting critical infrastructure, it is essential to focus not only on preventive measures but also on preparedness for managing the consequences of emergency situations. One of the most severe scenarios involves a potential terrorist attack on a nuclear facility, which could result in the release of radioactive substances and subsequent environmental contamination.

This paper aims to analyze the current state of decontamination procedures in the event of a radiation emergency at the Temelín Nuclear Power Plant. The study emphasizes the practical aspects of decontamination processes from the perspective of radiation protection personnel and members of the Temelín Fire and Rescue Service. Using qualitative research, based on structured interviews, the study evaluates their experience, equipment, methodologies, and the effectiveness of the used procedures. The results of the analysis provide an overview of the preparedness of individual units to respond to a radiation emergency caused by a terrorist attack and offer recommendations for improving the decontamination system.

1 Temelín nuclear power plant

There are two nuclear power plants in the Czech Republic: the Dukovany Nuclear Power Plant and the Temelín Nuclear Power Plant. Both power plants are equipped with WWER (water-water energy reactor) nuclear reactors and operate on the similar principle. However, they differ in terms of power output and structural layout (4, 18). The Dukovany Nuclear Power Plant is located on the border between the Vysočina and South Moravia regions and was commissioned in 1985–1988. It consists of four WWER 440 model V-213 pressurized water reactors. Each unit has a capacity of 510 MWe, giving the plant a total output of 2040 MWe (19).

The Temelín Nuclear Power Plant, situated in the South Bohemian region, was commissioned in 2002. Electricity is generated here by two WWER 1000 type V 320 production units. Each unit has a capacity of 1125 MWe, giving the plant a total output of 2250 MWe. Like Dukovany, Temelín generates approximately 15 TWh of electricity annually. To support the cooling system, the Hněvkovice Reservoir was constructed on the Vltava River (17, 18).

1.1 Terrorist attacks on nuclear power plants

Nuclear power plants are electricity-generating facilities and constitute an important and integral part of critical infrastructure. One potential cause of contamination at a nuclear power plant could be a terrorist attack. In the past, terrorist organisations

have demonstrated their willingness and ability to target critical infrastructure (3). Although nuclear power plants belong to the group of so-called "hard targets" - targets with a high level of protection against attack and unauthorized access. Terrorist objectives include: a) causing casualties (injuries and deaths), b) damaging or destroying critical infrastructure, c) disrupting the economy, d) harassing, weakening, or discrediting the government, e) discouraging tourism or investment due to perceived uncertainty, f) compelling people to change their daily routines or lifestyles (1). According to the US Department of Homeland Security (DHS), terrorism is defined as any activity involving an act that "is dangerous to human life or potentially destructive to critical infrastructure or key resources, and... must also be intended to: a) intimidate or coerce a civilian population, b) influence government policy through intimidation or coercion, or c) affect government conduct through mass destruction, assassination, or kidnapping" (6). Therefore, it is essential to address this issue. Terrorism targeting energy facilities, pipelines and transport routes is an increasingly significant threat to energy security, partly due to general tensions in global oil and gas market (5).

1.2 Contamination

Despite systematically implemented radiation protection measures, undesirable contamination with radioactive substances, known as contamination, may occur under certain circumstances. Contamination can result from a leak (planned or unplanned) from the primary circuit technology, causing radioactive substances to escape into the environment and potentially cause surface or air contamination (10).

Surface contamination

In this case, radioactive substances settle on the surface of people or objects, so surface contamination is not caused by radiation. Depending on whether the radioactive substance can be removed from the surface, surface contamination is classified as either removable and non-removable. The unit of measurement for surface contamination, or surface activity, is Bq/m² and its presence can be detected by using measuring instruments, hand-held devices or monitors for people. Effective protection against surface contamination includes the use of personal protective equipment and protective work equipment (10, 8).

Internal contamination

Internal contamination of a person occurs when a source of ionising radiation enters the body and irradiates it from within. Radionuclides can enter the body via inhalation, ingestion, or absorption through the skin. Depending on the properties of the radionuclide, various processes occur in the human body. Some radionuclides can be quickly eliminated by the body, while others, known as biogenic radionuclides, can accumulate in certain target organs (critical organs), which are then exposed to ionising radiation to a greater extent than other tissues. An example is the radioactive isotope iodine ¹³¹I, which is released into the environment in the event of a nuclear accident and, when ingested, settles in the thyroid gland and causes its irradiation. To prevent this process, one of the immediate protective measures during a nuclear accident is to take iodine tablets, known as iodine prophylaxis. The purpose is to saturate the thyroid gland with stable iodine, thereby protecting it from radioactive iodine. A high incidence of thyroid cancer has been observed primarily among individuals who were the Chernobyl Nuclear Power Plant at the time of the accident. In contrast, during the Fukushima nuclear accident, timely evacuation and other protective measures successfully prevented contamination with radioactive iodine (10, 7).

The intake of radionuclides by the human body can be assessed through direct or indirect measurement methods. Direct measurement is performed using a FastScan monitor, designed

for rapid assessment of internal contamination, and whole-body counters, which determine the distribution and activity of individual radionuclides in the human body. For iodine assessment in the thyroid gland, a specialized detector is applied directly to the gland. The presence of tritium is detected by analyzing urine samples. Indirect methods are based on estimating the effective dose or equivalent dose to be determined in situations where direct measurement cannot be used (lack of a whole-body monitor or inability to measure certain radionuclides by direct methods) or in emergency monitoring, when it is necessary to track the behaviour of radionuclides in the human body. Indirect measurement is based on the analysis of excreta, monitoring the working environment, or knowledge of the specific activity of radionuclide activity in the food chain (10, 7, 20).

1.3 Decontamination

Decontamination is a set of methods, procedures, organisational measures and means designed to effectively remove hazardous substances. It is a process aimed at reducing the spread of harmful materials, preventing secondary surface and internal contamination, and minimizing the risk of human exposure to radioactive substances through surface contamination. The objective of decontamination is to reduce the content of a hazardous substance to a safe level or to completely remove the substance from the surfaces of people, material resources and equipment. Its main purpose is to mitigate health consequences for affected persons, prevent irreversible damage, and shorten the duration of protective equipment use (14, 11, 12).

Depending on the type of harmful substance being removed, the following types of decontamination are distinguished:

- detoxification (decontamination) – chemical substances,
- decontamination – radioactive substances,
- disinfection – biological substances (15).

Decontamination is subdivided depending on the method applied:

- Dry decontamination method
- Wet decontamination method (15).

Furthermore, decontamination methods are divided into:

- Mechanical – suction, wiping, washing, uncovering, coating, etc.
- Physical – evaporation, sorption, dilution, etc.
- Chemical – based on changing the molecular structure of the contaminant through its reaction with a decontaminating agent, leading to decomposition or its transformation into less hazardous substances or substances that are easier to remove.
- Combined – a combination of the above methods (15, 13).

1.4 Decontamination carried out by radiation protection service personnel

Primarily, decontamination (or deactivation) of individuals and personal items contaminated during routine operations is performed by operational radiation protection personnel within the so-called emergency hygiene loop area (9).

Skin decontamination is performed to reduce contamination to the lowest possible level without causing skin damage. The procedure for proper and effective decontamination must be strictly followed. The first step is always hand decontamination, followed by other contaminated body parts.

Skin washing is typically carried out using decontamination soap and lukewarm water for about 2–3 minutes to prevent overhydration of the skin, as washing with hot water leads to undesirable pore opening and dilation. The process then continues according to the contaminated body area, always proceeding from top to bottom. Care must be taken to ensure that water does not enter the eyes or body openings, and particular

attention should be paid to thorough cleaning of hard-to-reach areas and places where contamination easily accumulates, such as under the nails and between the fingers. The total duration of decontamination should not exceed approximately 8 minutes.

After decontamination, a measurement is taken on the monitor. If decontamination has not been successful, the next cleaning cycle continues at approximately 10-minute intervals so as not to damage the skin. If cleaning is unsuccessful, the next decontamination cycle should be performed. The procedure usually progresses from the use of mild decontamination agents to stronger ones, from warm water, washcloths, acidic soap, through detergents such as Jar, Odekon, soda, Chelaton, citric acid, to actions such as cutting nails, shaving beards and hair, and cutting hair. If contamination is found in the head area, there is a risk of internal contamination, so it is always necessary to ensure measurement on FastScan or a whole-body detector. If decontamination carried out by dosimetrists in an emergency hygiene loop is ineffective i.e. the surface activity exceeds 0.3 Bq/cm² the contaminated person is sent for special decontamination at the company's medical centre (9, 7).

Dosimetrists also perform decontamination of small personal items such as ID cards, mobile phones, and dosimeters. To remove radioactive substances, they use industrial alcohol or adhesive tape to capture hot particles (16). Decontamination of technological systems and equipment is carried out by a specialized contractor using the previously mentioned methods — dry or wet techniques, and mechanical, physical, and chemical processes.

1.5 Decontamination performed by the plant fire and rescue service

Both the Temelín Nuclear Power Plant and the Dukovany Nuclear Power Plant have their own fire brigades, which are based directly in the secured area of the power plant. Their primary task is to be ready for possible action within the plant area, although they also operate in the surrounding region. Their daily tasks include technical interventions and assistance, such as fire watch during work on specific equipment, securing personnel, rescuing individuals from elevators, and other activities. One of their essential activities is performing the decontamination of both radioactive and chemical substances, which are also used at nuclear power plants (2).

When carrying out decontamination, the fire service at nuclear power plants follows the national methodological instructions of the Operational Manual for Fire Protection Units – Tactical Intervention Procedures, specifically Instruction No. 4N "Hazard of Ionising Radiation," No. L6 "Decontamination, Decontamination Area," No. L7 "Decontamination of Responders," No. L9 "Decontamination of Radioactive Substances," as well as the Standard Operating Procedure for Integrated Rescue System Units during Joint Intervention STČ – 01/IZS "Dirty Bomb." Decontamination is further performed in accordance with the specific action plan included in the External Emergency Plan for the Temelín and Dukovany Nuclear Power Plants (14).

The units decontaminate individuals exposed to hazardous substances, in the operation who have been exposed to hazardous substances, external surfaces of equipment, transport containers used for storing material resources, and material resources that cannot be placed in transport containers (17).

2 Methodology

For the purposes of analysing existing decontamination procedures at nuclear power plants, the Temelín Nuclear Power Plant was selected because it is our workplace and access to the necessary information is easier. It should be noted, however, that both sites share a unified management structure and follow the same procedures and methodologies; therefore, decontamination practices are standardized across both locations.

As nuclear power plants are among the most highly secured facilities in the country, certain information is classified. Consequently, only details that do not compromise the security of the facility will be presented.

The analysis of the current state of decontamination procedures was carried out using qualitative research, specifically through interviews with professionally qualified personnel.

One of the qualitative research methods used was interviews, which were divided into two groups: interviews with staff from the radiation protection department and the other with members of the plant's Fire and Rescue Service. Each group was asked questions to best capture their activities within the decontamination process. All employees who participated in the survey were employees of the Temelin Nuclear Power Plant. Interviews were selected as the research method due to the small number of employees in these positions, as well as because these individuals have a wealth of extensive experience, knowledge, and often many years of practice.

Prior to conducting the interviews, preparatory work was carried out, during which a set of questions relating to the issue was developed. This test set of questions was presented to one test subject from both the radiation protection department and the fire and rescue service. Based on the responses and feedbacks, the interview questions were slightly modified to reflect the topic as accurately as possible.

Interviews were then conducted with individual employees, with the aim of including at least one representative from each shift shift to ensure respondents were as independent as possible. Since the composition of these shifts is more or less constant, a certain precedent may be established, which everyone in the group follows. Data collection lasted several weeks, as all shifts needed to rotate through duty. The research was initially discussed with the heads of the relevant departments to determine whether and to what extent the information obtained could be used.

Each interview lasted approximately 10–15 minutes and was conducted at the respondent's workplace, i.e. in the case of dosimetrists, in the Central radiation control room, and in the case of firefighters, in the fire department of the plant. Before the interview, the respondent was informed of its purpose and objectives.

2.1 Description of the research sample

A total of 9 employees of the Radiation protection department at the Temelin Nuclear Power Plant were interviewed. Among them, 5 served as radiation safety technicians, 3 as Shift supervisors for Radiation control, and one as a Radiation risk management specialist. Additionally, 10 members of the fire and rescue service were interviewed, including 5 fire engine operators, 3 operations officers, and 2 team commanders. The data was subsequently evaluated and analysed, and specific research categories were selected for which responses were prepared. Based on the findings, procedures were proposed to improve the current situation.

Decontamination of individuals and small objects, as well as decontamination within the controlled area at the Temelin Nuclear Power Plant, is carried out by radiation protection personnel operating in continuous 8- hour shifts. Six shifts alternate according to the established schedule (red, purple, yellow, green, blue, and brown). In addition, two supplementary shifts — replacement and rainbow — have been created to reinforce standard shifts in the event of absence of permanent members. The shift is usually made up of a radiation control shift supervisor, who is the shift leader, and is in contact with the managers of other technological systems. The shift also includes radiation safety technicians, who work in shifts of at least two people (usually three), such a shift group is legally mandatory in accordance with the limits and conditions, and failure to meet these requirements would constitute a violation of the Atomic

Energy Act. The morning shift from Monday to Friday is additionally reinforced by an additional day shift, which, however, is not limited to the minimum number of dosimetrists on duty.

Decontamination of both chemical and radioactive substances outside the controlled area is carried out by the fire and rescue service of the Temelin Nuclear Power Plant. They operate in a continuous 12- hour shift system, alternating between four shifts (red, yellow, green and blue) replacing each other according to the established schedule. During each shift, the minimum number of firefighters on duty is 15, although typically 20-22 personnel are on duty.

In addition, in high-risk situations, decontamination is carried out by medical workers employed at the Temelin Nuclear Power Plant. From Monday to Friday, a plant doctor works on the morning shift at the nuclear power plant, but at the same time, rescuers from the South Bohemian Region work 12- hour shifts, each of whom actually works one shift per month.

2.2 Data collection

As part of the research, two sets of interviews were conducted on decontamination with experts working at nuclear power plants, specifically with employees of the radiation protection department who perform decontamination in the controlled area, as well as with employees of the plant's fire and rescue service, who carry out decontamination during incidents outside the controlled area. Both departments are part of the organisational structure of the security division, which is common to both plants.

The questions were formulated in advance as follows:

- **Radiation Protection (RP) Department Employees**
 1. Have you undergone specialized training in radiation protection?
 2. How often do you perform decontamination of individuals?
 3. Which documentation do you use to carry out decontamination?
 4. What methods do you use to perform decontamination?
 5. What equipment do you use?
 6. How effective is the decontamination you carry out?
 7. How do you handle contaminated water and the means used for decontamination?
- **Fire and rescue service employees (FRSE)**
 1. Do you undergo special training in decontamination/radiation protection?
 2. How often do you conduct decontamination training?
 3. Have you ever carried out decontamination (not training)?
 4. Have you undergone special training in decontamination/radiation protection?
 5. What equipment and techniques do you use when performing decontamination?
 6. How effective is the decontamination you carry out?
 7. How is contaminated water and equipment handled?

3 Results of interviews

This section presents the results of interviews conducted with employees of the radiation protection department and members of the plant's Fire and Rescue Service based on the questions asked.

Analysis of interviews

▪ **Radiation protection department staff**

The results of the interviews with employees of the Radiation Protection Department were divided into seven groups using coding

1) Education and qualification requirements (The results for this area are presented in Tab. 1)

Tab. 1: Category Education and qualification requirements [own]

Professional competence for performing activities from the perspective of radiation protection	All respondents unanimously stated that they had successfully completed a special professional competence course at the State Office for Nuclear Safety, commonly referred to as the PI course.
Basic training for nuclear power plant employees	All employees also mentioned that they had completed basic training at the ČEZ training centre, specifically modules M1 and M2.
Internal examinations	Additionally, they noted that it is necessary to pass so-called corporate examinations.

2) Frequency of decontamination (The results in this area are presented in Tab. 2)

Tab. 2: Category Frequency of decontamination [own]

During the main production unit (MPU) shutdown	During the shutdown of MPU, decontamination is performed much more frequently, several times a day.
Outside MPU shutdown	Outside of shutdown periods, it occurs only a few times a month.

3) Documentation and experience (The results in this area are presented in Tab. 3)

Tab. 3: Category Documentation and experience [own]

Method	The procedure for decontaminating personnel is established in the internal methodology "Radiation Protection Rules in the Controlled Area".
Subdivision specification	Further details are specified in the departmental instructions of the radiation protection department.
Operational experience	When performing decontamination, many dosimetrists rely on their many years of extensive experience and guidance from colleagues.

4) Method of implementation (The results in this area are presented in Tab. 4)

Tab. 4: Category Method of Implementation [own]

Decontamination method	The first step is to remove the work overalls and then wash the hands. If this is not sufficient, the individual should take a full-body shower from head to toe, ensuring that water does not enter body orifices. Initially, warm water and soap are used for a maximum of 8 minutes, which removes up to 90% of contamination. If several consecutive decontamination cycles are performed, after approximately 3 repetitions, the skin becomes softened; therefore, it is necessary to wait at least 20 minutes before the next cycle. In more complex cases, creams (Nivea, ISOLDA) are applied or procedures such as shaving, depilation, and hair cutting are performed. In practice, decontamination is carried out by the contaminated individual, and the dosimetrist determines how to carry out decontamination.
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5) Means used (The results in this area are presented in Tab. 5)

Tab. 5: Category Means used

Means used	Decontamination typically involves the use of warm water, decontamination soap (or non-decontaminating soap), shampoo without conditioner, a 2% citric acid solution, a brush, nail scissors, hair scissors, a razor, and adhesive tape. Technical alcohol is used for decontamination of objects.
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6) Decontamination results (The results in this area are presented in Tab. 6)

Tab. 6: Category Decontamination result [own]

Effectiveness of decontamination	The effectiveness of decontamination carried out by radiation protection service personnel is practically 100%, however, no formal statistics are maintained, and no contaminated individuals have required medical attention or consultation with healthcare professionals. Sometimes it is difficult to remove contamination, and the whole process takes longer. During decontamination, breaks are necessary to prevent skin maceration. During the operation of the nuclear power plant, there have been several cases where decontamination was unsuccessful, but even these individuals did not need to be referred to a doctor or medical personnel. The contamination level did not exceed any threshold requiring medical intervention but was higher than the clearance level for release into the environment. If internal contamination is suspected, typically involving only a few individuals during an outage, the person is sent to the personal dosimetry control station, where measurements for internal contamination are performed using a FastScan monitor and a whole-body counter. In all cases, internal contamination was not confirmed, and no medical intervention was necessary. Consequently, there was no need to activate the internal trauma plan, as the effective dose commitment threshold requiring referral to a physician was not exceeded.
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Procedure in case of unsuccessful decontamination	When decontamination is unsuccessful, workers follow the procedures described in the internal documentation. At the same time, they consult with the shift radiation control supervisor and, above all, with the head of the radiation protection and radiation risk management department.
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7) Radioactive waste management (RAW) (The results in this area are presented in Tab. 7)

Tab. 7: Category RAW management [own]

RAW management	Wastewater generated during the removal of radioactive substances is directed into a special sewer system and then routed to a filtration station
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	<p>in the active support services building.</p> <p>Tools (such as brushes, scissors, etc.) that come into contact with contaminated materials either decontaminated with water or alcohol, or disposed of at the designated collection point in the fragmentation area.</p>
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Analysis of conducted interviews

Employees of the fire and rescue service of the enterprise (FRSE)

The results of interviews with members of the Fire and Rescue service at the Temelín nuclear power plant were coded and divided into seven categories.

1) Education and qualification requirements (The results in this area are presented in Tab. 8)

Tab. 8: Category Education and qualification requirements [own]

OMEGA training	Firefighters complete an introductory training course called OMEGA
Training in radiation protection	Regarding radiation protection or chemical safety, the employer does not require specialized training in these areas. If an employee has undergone completed such training, it was during the employment with the regional fire service.

2) Decontamination training (The results in this area are presented in Tab. 9)

Tab. 9: Category Decontamination training [own]

Conducting decontamination training	Training exercises focused on decontamination of radioactive or chemical substances are conducted four times per year for each shift.
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3) Frequency of decontamination (The results in this area are presented in Tab. 10)

Tab. 10: Category Decontamination frequency [own]

Decontamination frequency	Since the nuclear facility was commissioned, no real decontamination of radioactive substances has been required. However, firefighters have experience in performing chemical substance decontamination.
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4) Documentation and experience (The results in this area are presented in Tab. 11)

Tab. 11: Category Documentation and experience [own]

Decontamination procedures	At the nuclear power plant, operations follow the operational regulations of the firefighting units.
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5) Decontamination techniques and equipment (The results in this area are presented in Tab. 12)

Tab. 12: Category Decontamination techniques and equipment [own]

Techniques and equipment for decontamination	For simplified decontamination, only fire hoses and tarpaulins are used. Otherwise, an inflatable decontamination tent is employed, and if necessary, a shower, a water tanker truck, and a gas mask machine.
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6) Decontamination results (The results in this area are presented in Tab. 13)

Tab. 13: Category Decontamination results [own]

Decontamination results	Decontamination performed by FRSE is effective, consistently meeting all required limits.
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7) Radioactive waste management (The results in this area are presented in Tab. 14)

Tab. 14: Category RAW management [own]

RAW management	If wastewater is found to be contaminated, it is pumped out and disposed of by a specialized company. Contaminated equipment is either decontaminated to the required levels or disposed of as radioactive waste. The disposal of radioactive materials and water is managed by a commander or a dosimetrist.
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Conclusion

The analysis presented in this paper confirmed the high level of preparedness and professional competence of personnel in the field of decontamination. Interviews revealed that both radiation protection staff and members of the plant's fire and rescue service possess the necessary knowledge, experience, and technical resources to manage radiological emergencies effectively. Current decontamination procedures are proven to be effective in practice and are implemented in accordance with internal guidelines and national regulations.

However, the study revealed certain differences in the frequency of professional training and the level of specialised exercises among different groups of employees. It is therefore recommended to strengthen a unified system of regular training and practical drills, including scenarios simulating non-standard situations such as targeted terrorist attacks.

Overall, the decontamination system at the Temelín Nuclear Power Plant is functional and well-organized. Future development should focus on achieving an even higher level of coordination between departments and systematically enhancing resilience to potential threats.

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Primary Paper Section: A

Secondary Paper Section: AQ

A BIBLIOMETRIC APPROACH TO UNDERSTANDING CORRUPTION IN SUBSIDIES: PUBLICATIONS AND TRENDS OVER TIME

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Abstract: This paper presents a bibliometric analysis of research on corruption in subsidy systems (1990–2024). Using WoS data and the Biblioshiny package in R, it maps publication trends and citation patterns. It also identifies core journals and collaboration networks in the field. The study adds a new perspective by examining geographical publishing disparities and thematic coverage. Results show a sharp rise in publications after 2010. Research is mainly concentrated in economics, political science and environmental studies. The US, China, and several EU countries dominate scholarly output. Keyword co-occurrence reveals clusters on governance/performance, energy/environmental subsidies, and agricultural policy. The paper highlights research gaps and proposes future directions to improve accountability in subsidy policy.

Keywords: corruption; subsidies; bibliometric analysis; public policy; governance; energy subsidies; agricultural policy

1 Introduction

Subsidies are widely used policy instruments that support economic activity, reduce inequality, and promote social welfare. At the same time, they are highly vulnerable to corruption, which can distort allocation, create fiscal burdens, and erode public trust in government. Bribery, clientelism, and rent-seeking by politically connected actors may redirect public resources away from intended beneficiaries and undermine the original policy objectives of subsidy schemes. Research indicates that corruption can lead to significant inefficiencies, with studies showing that up to 30% of subsidy funds may be lost to corrupt practices in certain sectors. This quantifiable leakage highlights the scale of the problem, emphasising the need for robust anti-corruption measures.

Although corruption and public finance have been the subject of extensive research, studies explicitly focusing on corruption in subsidy systems remain fragmented across sectors such as agriculture, energy, and social welfare. Existing work is dispersed across multiple disciplines and journals, making it difficult to obtain a clear picture of how this research field has developed, who its main contributors are, and which themes dominate the debate. To navigate this fragmentation, a cross-disciplinary narrative could be constructed by integrating diverse perspectives under a unifying theoretical framework, such as agency theory. This lens can provide a cohesive framework for understanding how principal-agent dynamics operate across fragmented research areas, offering clearer insights into the systemic patterns of corruption associated with subsidies.

This paper addresses that gap by conducting a bibliometric analysis of publications on corruption in subsidies indexed in the Web of Science database between 1990 and 2025. Using the Biblioshiny package in R, it examines trends in scientific production and citations, identifies core journals, countries, and authors, and maps key thematic clusters related to governance, policy design, and the distributional and environmental impacts of subsidies. The findings provide a structured overview of the literature and point to research gaps, particularly the limited evidence from low- and middle-income countries. This research is particularly pertinent to ongoing policy debates, such as the World Trade Organisation's subsidy rules, which aim to balance the need for subsidies in economic development with their potential misuse due to corruption. By linking our analysis to such active reform agendas, we highlight the urgency of addressing these gaps to inform more effective policy-making.

2 Theoretical Background

Corruption is commonly defined as the abuse of entrusted power for private gain and is widely recognised as an obstacle to

growth, efficient public spending, and inclusive development (Mauro, 1995; Bardhan, 1997; Svensson, 2005). Empirical studies show that corruption reduces investment, increases transaction costs, and distorts the allocation of public resources (Mauro, 1995; Gupta et al., 2002). In subsidy systems, these distortions translate into fund leakage, weak targeting, and the reinforcement of existing inequalities, as benefits are diverted to politically connected or better-off groups (Gupta et al., 2002; Shleifer & Vishny, 1993).

Theoretical explanations often draw on Principal-Agent theory and rent-seeking models. Principal–agent frameworks emphasise information asymmetries and weak monitoring, which allow public officials to pursue private benefits rather than social welfare (Jensen & Meckling, 1976; Jain, 2001). Rent-seeking theory highlights how economic actors invest resources to capture policy-generated rents, such as subsidies, rather than engage in productive activities (Krueger, 1974). In decentralised or weakly governed settings, this can be exacerbated by fragmented accountability and limited oversight (Fisman & Gatti, 2002; Svensson, 2005).

Subsidies themselves are widely used instruments to support strategic sectors, promote industrialisation, and protect vulnerable households (Birdsall & de la Torre, 2001; Harrison & Rodríguez-Clare, 2010; OECD, 2019). However, evidence from agriculture and energy shows that poorly governed subsidy schemes often benefit large firms and wealthy producers rather than low-income households, while also creating fiscal burdens and environmental externalities (Coady et al., 2015; Sovacool, 2017). This tension between policy objectives and implementation outcomes makes the interaction between corruption and subsidies a critical research topic.

Bibliometric methods provide a systematic way to map this dispersed literature by analysing citation links, co-authorship networks, and thematic structures (Small, 1973; Aria & Cuccurullo, 2017). Recent applications demonstrate how bibliometric tools can identify core themes, influential authors, and emerging research fronts in corruption studies (Donthu et al., 2021; Aria & Cuccurullo, 2017). Applying these methods specifically to the nexus of corruption and subsidies can therefore clarify how the field has evolved and where essential research gaps remain.

3 Data and Methodology

This study is based on bibliographic records retrieved from the Web of Science Core Collection. The search combined keywords related to corruption and subsidies (e.g., corruption, bribery, rent-seeking with subsidies, subsidy schemes, state aid) to capture documents that explicitly address the interaction between these two phenomena rather than either in isolation. The time window was set to 1990–2024 to cover more than three decades of research.

The initial search results were exported from Web of Science and processed in the Biblioshiny interface of the Bibliometrix package for R (Aria & Cuccurullo, 2017). Duplicates were removed, and author names, journal titles, and institutional affiliations were standardised to reduce problems caused by spelling variations and inconsistent use of initials. Records with missing fields were kept for basic descriptive statistics but excluded from analyses that required complete information, such as citation or keyword analysis.

To trace changes over time, the final dataset was divided into four sub-periods: 1990–1999, 2000–2009, 2010–2019, and 2020–2025. For each period, we computed indicators of scientific production (number of publications per year and document types) and citation impact (total citations and average citations per document).

The empirical strategy combines several bibliometric techniques. Descriptive statistics summarise publication and citation trends across time and disciplines. Citation analysis identifies highly cited documents, influential authors, and core journals in the field (Small, 1973). Authorship and country-level indicators are used to assess research productivity and international collaboration patterns.

Keyword frequency and co-occurrence analysis provide insight into the main thematic areas and their evolution, highlighting how governance, energy and agricultural subsidies, and inequality have emerged as central topics. Co-authorship and keyword co-occurrence networks are visualized using Biblioshiny to map the social and intellectual structure of the research field. Additionally, examining network centrality measures, such as betweenness centrality, can reveal which authors or countries act as key connectors in the collaboration landscape. Identifying these hidden gatekeepers can enrich our understanding of collaborative dynamics and encourage more inclusive research networks. Together, these methods offer a systematic overview of how the literature on corruption in subsidies has developed and identify critical research gaps.

4 Results

4.1 Publication and Citation Trends

The analysis of annual scientific production shows a precise and rapid increase in the volume of publications on corruption in subsidies over the period 1990–2024. In the 1990s, only a handful of documents were published each year, indicating that the topic attracted limited academic attention (Figure 1). From around 2006 onwards, the number of articles began to rise steadily, and this trend accelerated after 2016. The sharpest increase is observed in the period 2020–2024, when the annual output reaches its highest levels.

This pattern is consistent with growing global concern about the fiscal, social, and environmental implications of subsidy policies and their vulnerability to corruption. The rapid growth in publications reflects intensified debates on public spending, transparency, and sustainable development, particularly in sectors such as energy and agriculture.

Citation data follow a similar trajectory. Both the total number of citations and the average number of citations per document increase markedly over time, with a pronounced rise after 2010. This fact suggests that research on corruption in subsidy systems has not only expanded in volume but has also gained influence within the broader literature on corruption, governance, and public finance. The combination of rising publication counts and growing citation impact indicates the emergence of corruption in subsidies as a distinct and relevant research field. However, it is essential to acknowledge that using field-normalised citation scores could provide a different perspective on this influence, potentially highlighting variations in impact across different fields of study.

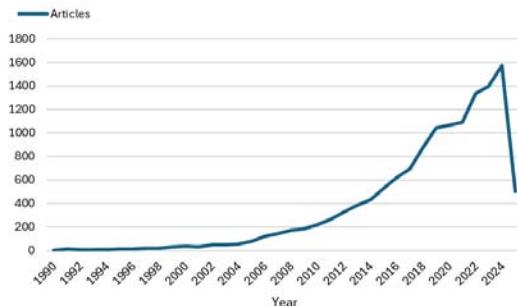


Figure 1: Annual scientific production on corruption and subsidies, 1990–2024. Source: Author's own elaboration based on Web of Science data using Biblioshiny (R package Bibliometrix)

Beyond the general upward trend, the graphs also reveal a particularly sharp spike in publications in the early 2020s. This surge is due to several overlapping developments: intensified debates on the fiscal sustainability of large subsidy programmes, mounting pressure to reform energy and agricultural subsidies in line with climate and environmental goals, and heightened public scrutiny of corruption in the wake of economic and political crises. A defining global event that contributed to this spike was the widespread implementation of COVID-19 relief subsidies. These emergency measures not only highlighted existing vulnerabilities in subsidy systems but also triggered significant public and academic interest in understanding and mitigating corruption risks associated with rapid policy responses. As these factors have pushed subsidy design and governance questions higher on policy agendas, there has been an acceleration of both publication and citation activity. The dynamics observed in 2022–2024, therefore, suggest that research on corruption in subsidies is not only expanding but also increasingly responsive to real-world shocks and reform debates.

4.2 Core Journals and Source Impact

The analysis of journal publications reveals significant growth in research on corruption in subsidies in a relatively small group of core outlets (Figure 2). Journals such as Sustainability, Energy Policy, World Development, Journal of Business Ethics, and Journal of Cleaner Production show a notable increase in the number of published articles over recent years.

These journals cover topics ranging from energy and environmental policy to development economics and business ethics, which reflects the interdisciplinary nature of the field. Energy Policy and Journal of Cleaner Production stand out with higher Impact Factors and H-indices, indicating that they host many of the most cited and influential articles on subsidy governance and corruption. Sustainability contributes significantly to the work at the intersection of subsidies, sustainable development, and environmental policy.

The upward trajectory of publications across these journals suggests a shift from sporadic case studies to a more systematic, cross-disciplinary research agenda. As global discussions on subsidy reform, climate policy, and responsible public spending intensify, these outlets have become central platforms for academic debate on corruption in subsidy systems.



Figure 2 Most relevant journals publishing on corruption and subsidies, 1990–2024. Source: Author's own elaboration based on Web of Science data using Biblioshiny (R package Bibliometrix).

4.3 Geographical Distribution of Research Output

The global distribution of publications on corruption in subsidies is highly uneven (Figure 3). A world map of publication frequency shows that North America and East Asia are the primary drivers of scholarship in this area, with the United States and China emerging as the most prolific contributors. These countries have large and complex subsidy systems and host many influential universities and research institutions, which helps explain their leading role.

European countries, particularly Germany, France, and the United Kingdom, also exhibit substantial research activity, though at lower levels than those of the United States and China. Their contributions are closely linked to debates on the effectiveness and accountability of subsidy policies within the European Union, especially in agriculture and energy.

In contrast, Africa and Latin America exhibit relatively low publication frequencies despite the high practical relevance of subsidies and governance challenges in these regions. This gap likely reflects constraints related to research funding, academic capacity, and data availability. It also points to an essential imbalance in the evidence base: much of what we know about corruption in subsidies is driven by work from North America, Europe, and East Asia, while low- and middle-income regions remain underrepresented.

The geographical patterns observed in Figure 3 highlight the potential for future cross-regional collaboration. Strengthening research capacity and data collection in Africa and Latin America could address context-specific challenges and broaden the global understanding of how corruption affects subsidy systems.

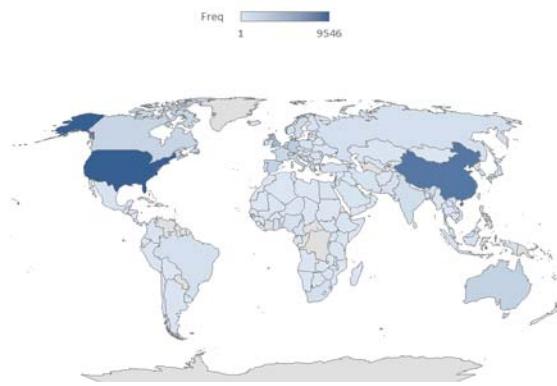


Figure 3 Global scientific production on corruption and subsidies by country, 1990–2024. Author's own elaboration based on Web of Science data using Biblioshiny (R package Bibliometrix).

4.4 Keyword Trends and Thematic Focus

Keyword analysis reveals how the literature on corruption and subsidies has evolved across core concepts, sectors, and policy debates. The most frequent author keywords, such as corruption, subsidies, governance, and institutions, form the conceptual backbone of the field and appear consistently across the whole period. Over time, they are increasingly complemented by terms related to energy, environmental policy, sustainability, and inequality, indicating a gradual shift towards governance and sustainability-oriented research questions. Taken together, the keyword trends and thematic maps illustrate how the field has shifted from a narrow focus on public finance to a broader agenda that links subsidies to development, distributional outcomes, and environmental challenges.

4.4.1 Evolution of Key Topics Over Time

The analysis of keyword trends over time reveals essential shifts in the academic focus surrounding corruption in subsidies (Figure 4). The term "corruption" shows the most pronounced increase, especially from the 2010s onwards, reflecting a growing interest in how corrupt practices shape the design and implementation of subsidy schemes. The keyword "subsidies" follows a similar upward pattern, indicating that many of these studies explicitly link corruption to subsidy systems rather than treating the two topics separately.

Other frequently used keywords, such as "governance", "performance", "policy", "determinants", "institutions", and "government", also show rising trends, though at varying intensities. Their growing presence suggests a stronger emphasis

on understanding how institutional quality, policy design, and administrative capacity influence the effectiveness and fairness of subsidies.

In recent years, keywords related to sustainability, environmental policy, and energy subsidies become more prominent, signalling a shift towards integrating corruption and subsidy research with debates on climate change, energy transition, and sustainable development. Overall, Figure 4 documents a move from a relatively narrow focus on corruption and public finance to a broader agenda that connects subsidies with governance, distributional outcomes, and environmental impacts.

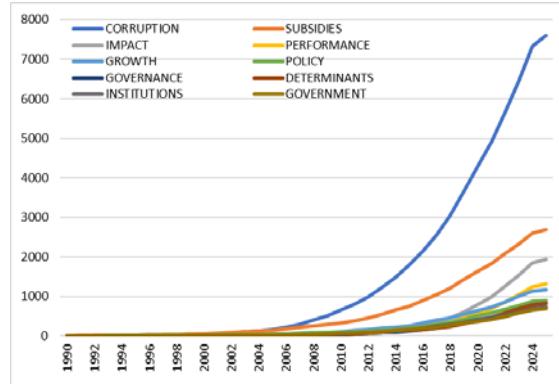


Figure 4 Temporal trends of the most frequent author keywords related to corruption and subsidies, 1990–2024. Source: Author's own elaboration based on Web of Science data using Biblioshiny (R package Bibliometrix).

4.4.2 Keyword Co-occurrence Network

The co-occurrence network provides a more detailed picture of how key concepts relate within the literature (Figure 5). The central node "corruption" is closely linked to terms such as "performance", "impact", "governance", and "institutions", indicating that many studies investigate the consequences of corruption for economic outcomes and policy effectiveness.

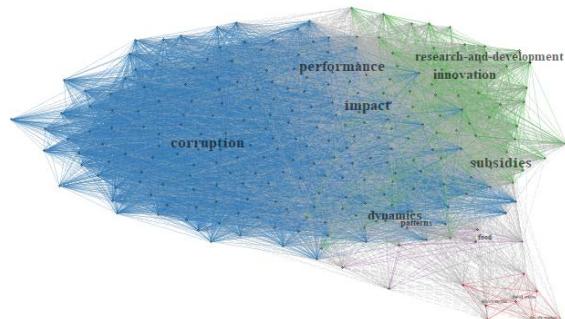


Figure 5 Keyword co-occurrence network in the literature on corruption and subsidies. Author's own elaboration based on Web of Science data using Biblioshiny (R package Bibliometrix).

A distinct cluster groups keywords like "subsidies", "research and development", "innovation", and "economic growth", highlighting work on the role of subsidies in promoting (or hindering) innovation and long-term development. Another cluster around "food" and "agriculture" points to a specific focus on agricultural subsidies and food security, particularly in countries where these programmes are extensive and politically sensitive.

The structure of Figure 5 underscores the multi-dimensional nature of the field: corruption in subsidy systems is analysed not only as a governance issue but also in relation to growth, inequality, innovation, and sectoral policies.

4.4.3 Trend Topics and Thematic Development

The trend topics visualisation further clarifies how thematic priorities have evolved (Figure 6). Earlier years are dominated by general notions such as "government", "trade policy", and "subsidies", while later periods see a substantial rise in topics like "corruption", "governance", "performance", and "policy reform". More recently, terms related to "environmental policy", "eco-innovation", and "sustainability" become increasingly frequent, reflecting the integration of environmental and climate concerns into the study of subsidy systems.

Together, Figures 4–6 show that the literature has gradually shifted from basic discussions of subsidy mechanisms and public finance towards a more complex, governance- and sustainability-oriented research agenda. Corruption is understood as a key determinant of whether subsidy policies support or undermine broader objectives such as economic development, social justice, and environmental protection.

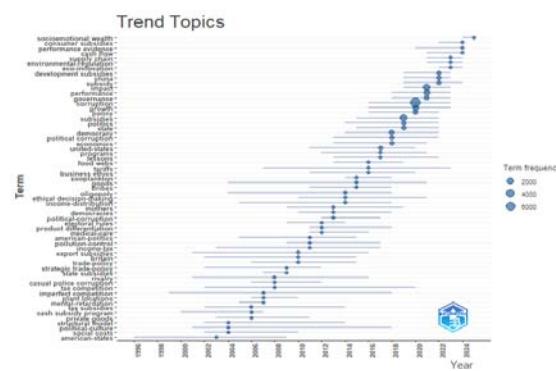


Figure 6 Temporal trends of the most frequent author keywords related to corruption and subsidies, 1990–2024. Author's own elaboration based on Web of Science data using Biblioshiny (R package Bibliometrix).

4.5 Research Gaps

Across publication patterns, country distributions, and keyword analyses, several research gaps emerge. First, the geographical concentration of studies in high-income countries contrasts with the limited evidence from low- and middle-income economies, particularly in Africa and Latin America, where subsidy systems and governance problems are often highly relevant. Second, cross-country and comparative analyses remain relatively scarce compared to single-country or sector-specific case studies, limiting the ability to draw broader conclusions about how institutional quality and political context shape corruption in subsidy schemes. Third, only a small part of the literature explicitly evaluates the impact of anti-corruption, transparency or digitalisation reforms on the performance and targeting of subsidies.

These gaps suggest promising directions for future research. More work is needed on underrepresented regions, on systematic cross-country comparisons, and on the design and effectiveness of concrete policy interventions to reduce corruption in subsidy systems while supporting sustainable and inclusive development.

The distribution by subject area confirms this pattern. Economics and business, environmental sciences, and public administration are the most represented fields, while law and regional studies appear as smaller but growing niches. This suggests that research on corruption in subsidies increasingly connects with debates on sustainability, climate policy, and regulatory quality.

5 Conclusion

This paper provides a bibliometric overview of the literature on corruption in subsidy systems over the period 1990–2024, using

data from the Web of Science and the Biblioshiny tool in R. The results show an apparent, accelerating increase in both scientific production and citation impact, particularly after 2010, indicating that the intersection of subsidies and corruption has become an increasingly important topic in academic debates. The growth in publications is accompanied by a gradual shift from sporadic case studies to a more structured and interdisciplinary research field.

The analysis of journals and subject areas highlights a small group of core outlets in economics, environmental studies, development and business ethics that have become central platforms for this research. At the same time, the geographical distribution of publications shows an intense concentration in high-income countries such as the United States, China, and several European economies, while many low- and middle-income regions remain underrepresented. Co-authorship patterns suggest that international collaboration is growing, but still predominantly within and between advanced economies.

Keyword trends and thematic maps indicate that the literature has shifted from a narrow focus on corruption and public finance to a broader agenda that links subsidy systems to governance, institutional quality, inequality, and environmental challenges. Governance and energy-related topics act as "motor themes," while agricultural subsidies, social policy, and regional issues appear as essential but less developed areas. Across these dimensions, several gaps emerge: limited evidence from underrepresented regions, a relative scarcity of comparative cross-country studies, and only modest attention to the evaluation of concrete anti-corruption and transparency reforms. Notably, of the numerous studies reviewed, only about 15% conduct cross-country analyses, highlighting the significant gap in comparative research that is critical for understanding the nuances of corruption across different national contexts.

Future research could address these gaps by strengthening empirical work in low- and middle-income countries, developing systematic comparative analyses of institutional and political determinants of corruption in subsidy schemes, and assessing the effectiveness of policy instruments aimed at improving transparency, targeting and accountability. By doing so, the academic literature can provide more robust guidance for policymakers seeking to design subsidy systems that support, rather than undermine, sustainable and inclusive development.

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Primary Paper Section: A**Secondary Paper Section: AH**

A PILOT EVALUATION OF AN INTERVENTION PROGRAM TO REDUCE PSYCHOLOGICAL VULNERABILITY AND STRESS IN UNIVERSITY STUDENTS

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Abstract: This pilot study developed and evaluated a six-week acceptance and commitment therapy-based intervention with an emphasized mindfulness component. Four university students participated in the intervention, and four served as a control group. Psychological vulnerability, operationalized as risk work-related patterns, and perceived stress were assessed before and after the intervention. In the intervention group, two participants showed a shift toward more adaptive work-related patterns, and stress levels decreased in two participants, whereas no pattern changes and increased stress were observed in two cases in the control group. Participants in the intervention group also reported satisfaction with the intervention and perceived subjective benefits. These preliminary findings indicate potential effectiveness and support further evaluation.

Keywords: psychological vulnerability, stress, acceptance and commitment therapy, mindfulness, university students

1 Introduction

Among various occupational and age groups, university students have consistently been shown to be at risk for poor mental health outcomes and decreased well-being, manifested, for example, in high levels of distress, anxiety, and depression (e.g., Evans et al., 2018; Stallman, 2010). Up to 83.9% of surveyed student populations report elevated distress levels, which increasingly reduce their capacity for work or study activities and lead to diminished academic achievement (Stallman, 2010). These mental health challenges may partly reflect the upheavals of emerging adulthood (approximately ages 18–29), including identity struggles and limited social support (Arnett et al., 2014). An additional burden is the transition from school to university, which brings increased responsibilities and heightened pressure related to academic performance and career planning (Beiter et al., 2015). Moreover, the number of university students with serious mental health challenges has risen worldwide in the context of recent global crises, including the COVID-19 pandemic, climate change, armed conflicts, and shortages of essential commodities, which have exacerbated the challenges individuals face in their daily lives (Cao et al., 2020). Recent data indicate that 36.6% of European university students display clinical levels of anxiety and 11.3% display clinical levels of depression. Czech university students show even higher rates, with 40.1% and 12.3% displaying clinical levels of anxiety and depression, respectively (Vallone et al., 2023). Another matter of concern is increased psychological vulnerability, or vulnerability to occupational health issues, observed in up to 69% of Czech students (Mašková, 2024). This vulnerability not only has immediate negative effects on individuals but also increases the risk of developing serious physical and mental health problems in the long term if left unaddressed (Schaarschmidt, 2005). Taken together, these findings underscore an urgent need for effective mental health interventions for university students, which the present study seeks to develop and pilot-evaluate.

1.1 Psychological vulnerability

A central concept of this study is psychological vulnerability, which is grounded in the model of Work-related Coping Behavior and Experience Patterns (*Arbeitsbezogenes Verhaltens- und Erlebensmuster* in German; AVEM; Schaarschmidt & Fischer, 2008). This concept refers to individuals' experiences of occupational stress and the typical behavioral responses they use to cope with such stress. Classification into a specific work-related pattern is based on a diagnostic inventory of the same name, which captures health-relevant constellations of motivation, coping resources, and emotional functioning. Based on the degree to which an individual's responses correspond to prototypical pattern profiles, individuals can be assigned to one

of four work-related patterns. Two of these patterns are considered healthy (patterns G and S), whereas the remaining two indicate increased psychological vulnerability and are associated with long-term risks to occupational health (risk patterns A and B). From this perspective, this diagnostic approach enables early identification of individuals at increased risk and supports the targeting of preventive interventions before health problems fully develop.

The characteristics of the four work-related patterns are as follows: (1) Pattern G (Healthy Ambitious): A health-promoting profile characterized by high but balanced professional commitment, strong coping resources, and high subjective well-being. Individuals can engage deeply in work while maintaining emotional distance and resilience. (2) Pattern S (Unambitious): Marked by low professional commitment and reduced work investment, but with adequate coping capacity and high well-being. Although health is not at risk, motivation tends to be low, and engagement is minimal. This pattern may act as an energy-saving strategy under stressful conditions. (3) Risk pattern A (Excessively Ambitious): Defined by very high commitment (strong ambition, perfectionism, overexertion) combined with weak coping resources and limited emotional detachment. Individuals experience high strain and low emotional reward, which increases vulnerability to stress-related health problems. (4) Risk pattern B (Resigned): The least favorable profile, combining low professional commitment with very low coping capacity and poor well-being. It mirrors core features of burnout—exhaustion, negative emotions, and withdrawal—and signals heightened long-term vulnerability to occupational health issues (Kieschke & Schaarschmidt, 2008; Schaarschmidt & Fischer, 2008).

Psychological vulnerability, reflected in assignment to risk patterns A and B, has been identified in a substantial proportion of Czech university students (Mašková, 2024). This finding is particularly concerning given the relative stability of these patterns, which tend to persist or shift toward less adaptive patterns in the absence of targeted intervention, making spontaneous improvement unlikely (Schaarschmidt, 2005). Despite this, evidence-based interventions aimed at reducing psychological vulnerability among university students remain scarce. One exception is a targeted intervention program developed specifically for teacher education students. The Strengthen for the Teaching Profession program consisted of an initial three-day intensive training followed by an eight-week application phase. During the training, participants completed core modules related to professional competencies and developed an individual action plan based on self-assessment, which was subsequently implemented and reflected upon during the application phase. In the full version of the program, the proportion of students classified into risk patterns decreased significantly, while the proportion classified into the most desirable pattern G increased markedly, from 27% at pretest to 55% at posttest (Çelebi et al., 2014). Despite its effectiveness, the program's focus on teacher education students limits its broader applicability, highlighting the need for efficient and widely applicable interventions within higher education.

1.2 Acceptance and commitment therapy

The present study focuses on a promising new psychotherapeutic approach: Acceptance and Commitment Therapy (ACT), which is a modern behavior therapy belonging to the third-wave cognitive-behavioral therapy (CBT) approaches. Rather than seeking to change the form or frequency of unwanted thoughts and emotions, its goal is to cultivate psychological flexibility, which enables individuals to live a more rewarding life even in the presence of undesirable thoughts and emotions. The underlying mechanism of ACT is strengthening six core processes: (1) Acceptance – opening up to unpleasant emotions and sensations instead of fighting them. (2) Cognitive defusion –

reducing the literal impact of thoughts by shifting how one interacts with them. (3) Contact with the present moment – cultivating mindful, non-judgmental awareness of ongoing experience. (4) Self-as-context – adopting the perspective of an observing self-distinct from thoughts and feelings. (5) Values – clarifying personally meaningful life directions. (6) Committed action – taking concrete steps toward goals that are guided by these values (Hayes et al., 2006). Although research on ACT effectiveness has been introduced only recently, it shows promising results, which even suggest its superior effectiveness for treating certain mental health issues compared to other more established psychotherapeutic approaches, such as CBT. A recent meta-analysis showed a medium to large effect of group ACT on anxiety symptoms and a small to medium effect on depressive symptoms. The most common formats for group ACT interventions were 6–12 sessions of 90 or 120 minutes, delivered on a weekly basis. The 6–12-session format showed a superior effect over shorter formats. The student group was one of the samples for which the largest effect size was found (Ferreira et al., 2022). To date, there are several dozen studies focused on examining the intervention effect of group ACT on various outcomes in university students. These interventions have resulted in numerous short- and long-term positive outcomes, such as increased psychological flexibility, well-being, school engagement, academic performance, the importance of education-related values, and time and effort management skills. They have also decreased stress, anxiety, depressive symptoms, self-harming tendencies, and suicidal ideation (Browning et al., 2023; Grégoire et al., 2018).

1.3 Mindfulness-based interventions

Mindfulness is most commonly described as “the awareness that emerges through paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment” (Kabat-Zinn, 2003, p. 145). Although rooted in Buddhist philosophy, mindfulness was adapted into a secular psychological approach with the development of the Mindfulness-Based Stress Reduction program by Jon Kabat-Zinn in 1979. Since then, mindfulness-based interventions have been widely adopted across clinical and non-clinical settings, particularly in high-stress populations. Accumulating evidence indicates that mindfulness-based interventions are associated with a broad range of beneficial outcomes for both mental and physical health. Current models suggest that the effects of mindfulness-based interventions are mediated at both neurobiological and psychological levels. Neurobiological mechanisms involve changes in brain systems responsible for stress regulation, whereas psychological mechanisms center on decentering (also termed metacognitive awareness or non-attachment), defined as observing thoughts, emotions, and bodily sensations with psychological distance. This process enables more flexible and deliberate responses to internal experiences and supports the cultivation of a more accepting and objective awareness of the present moment (Creswell, 2017). In university students, evidence from a meta-analysis of randomized controlled trials indicates that mindfulness-based interventions are effective in reducing stress and anxiety and in improving depression, well-being, and rumination (Dawson et al., 2020). Evidence from the Czech context further supports the effectiveness of mindfulness-based approaches for university students. Světlák et al. (2021) developed an eight-week online mindfulness-based program delivered to a large sample of university students ($N = 692$). The intervention produced large effect sizes for stress reduction, alongside significant decreases in the frequency and intensity of negative affect and increases in mindfulness and self-compassion. Although mindfulness is a core component of ACT, within the ACT framework it primarily serves a functional role in enhancing present-moment awareness and psychological flexibility through a more open and non-judgmental relationship with internal experiences (Hayes et al., 2006). The present intervention program placed a particular emphasis on mindfulness training as a distinct element, extending beyond brief experiential exercises typically used in ACT to include structured meditative practices such as the body scan exercise. This decision is grounded in the robust evidence

base supporting mindfulness-based interventions in university students, as well as in their demonstrated effectiveness within the Czech cultural and educational context.

2 The present study

University students represent a high-risk population with respect to perceived stress and psychological vulnerability. To contribute to the range of available intervention programs targeting this population, particularly in the Czech context, the present study develops a six-week intervention program based on ACT, with a specific emphasis on mindfulness. The study aims to provide a pilot evaluation of this intervention program and is guided by the following research questions:

RQ1: Are there differences between students participating in the intervention program and those not participating in the program in levels of perceived stress and psychological vulnerability before and after the intervention?

RQ2: What are the experiences of students participating in the intervention program?

3 Method

3.1 Participants

Participants were eight students from the University of West Bohemia enrolled in the course Personality Psychology during the summer term of 2025. Four students constituted the intervention group (I1–I4); inclusion criteria required completion of both the pre- and post-intervention surveys and attendance at the majority of the intervention sessions. The remaining four students formed the control group (C1–C4); inclusion criteria required completion of both the pre- and post-intervention surveys and non-participation in any of the intervention sessions. Participant characteristics are presented in Table 1.

Table 1: Participant Characteristics

Participant	Gender	Age	Faculty	Field of study	Year of study
I1	Female	22	Faculty of Philosophy	Humanities	3
I2	Male	23	Faculty of Applied Sciences	Distributed Computing Systems	4
I3	Male	22	Faculty of Philosophy	Humanities	3
I4	Male	21	Faculty of Philosophy	International Relations	2
C1	Male	25	Faculty of Applied Sciences	Software and Information Systems	4
C2	Female	22	Faculty of Philosophy	Humanities	3
C3	Female	21	Faculty of Philosophy	Humanities	3
C4	Male	22	Faculty of Philosophy	Humanities	3

Note. Students in years 1–3 were enrolled in a bachelor's degree program, whereas students in year 4 were enrolled in a follow-up master's degree program, with the fourth year corresponding to the first year of a two-year master's program.

3.2 Procedure

The intervention consisted of six weekly sessions, each lasting approximately 90 minutes, delivered as part of regular course meetings. The sessions were conducted during the final six weeks of the semester within the course Personality Psychology, a voluntary course offered to students at the University of West Bohemia. Each session typically began with a brief mindfulness exercise lasting 10–15 minutes, followed by psychoeducational input related to the respective ACT core processes. This was complemented by experiential, hands-on exercises and subsequent reflection, which took place either through group discussion or in written, non-shared form, depending on the

nature of the exercise and participants' willingness to share. An overview of the intervention structure and key practical exercises is provided in Table 2.

Table 2: The Structure of the Intervention Program

Session	Core process	Practice
1	Contact with the present moment	Mindful listening Five senses grounding exercise Body scan Brief breathing-based grounding (<i>Dropping the anchor</i>)
2	Cognitive defusion	Leaves on a stream, "I notice that I am having a thought that..." Passengers on the bus
3	Self-as-context	Mindfulness exercise focused on observing awareness Sky and weather and Chessboard metaphors Reflection on continuity of the observing self across changing experiences
4	Acceptance	Mindfulness of unpleasant bodily sensations Visualizing emotions as objects Compassion-oriented exercise toward one's own difficult experiences
5	Values	Five senses grounding exercise The 80 th birthday exercise Identifying values in meaningful past experiences Values sorting across life domains
6	Committed action	Body scan Small steps planning linked to identified values Point-of-choice framework

The pre-intervention survey was completed within one week prior to the first intervention session during March 2025 (T1), and the post-intervention survey was completed one week after the final intervention session during May 2025 (T2). Participants were asked to generate a confidential identification code that allowed matching of T1 and T2 responses and enabled them to receive individual feedback while maintaining confidentiality. Approximately two weeks after completing the T2 survey, students who participated in the intervention program were invited to provide brief qualitative feedback on the program, guided by the question: "What is your experience with the intervention program? How would you reflect upon the program content?" Attendance at the intervention sessions, as well as completion of the pre- and post-intervention surveys, was voluntary and was not controlled or penalized as part of the course requirements. All participants provided informed consent prior to participation.

3.3 Measures

Work-related patterns were assessed using the Czech version of the AVEM inventory, which contains 66 items and employs instructions adapted for a student population (Mašková et al., 2022). The inventory comprises 11 scales, with items rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Czech adaptation demonstrates good psychometric properties, with Cronbach's α coefficients ranging from .70 to .85. Perceived stress was assessed using the 10-item Perceived Stress Scale (PSS-10), originally developed by Cohen and colleagues and validated for Czech populations by Buršková Brabcová and Kohout (2018). The scale measures the degree to which individuals perceive situations in their lives as stressful during the past month. Items are rated on a five-point Likert scale ranging from 0 (never) to 4 (very often). Six items are negatively worded and indicate higher perceived stress, whereas four positively worded items are reverse-scored. Total scores range from 0 to 40, with higher scores reflecting greater perceived stress. In the Czech validation study, the scale showed high internal consistency (Cronbach's $\alpha = 0.87$).

3.4 Data analyses

Participants were assigned to one of the four work-related patterns using the algorithm provided by the authors of the

AVEM inventory, which also generates the level of concordance between each participant's responses and each of the four patterns. Perceived stress was calculated as the total stress score by reverse-scoring the positively worded items and summing the scores across all 10 items. These procedures were performed for each participant separately for T1 and T2. All analyses were conducted in IBM SPSS 25.

4 Results

The results of the pre- and post-intervention surveys, including the percentage match with each work-related pattern, the dominant pattern, and perceived stress levels at T1 and T2 for all participants, are presented in Table 3.

Table 3: The Results of the Pre-Intervention and Post-Intervention Surveys

Participant	Time	%G	%S	%A	%B	Pattern	Stress
I1	T1	0	0	0	100	B	28
	T2	0	0	0	100	B	32
I2	T1	42	1	54	3	A	16
	T2	73	3	23	1	G	10
I3	T1	0	0	0	100	B	28
	T2	0	1	0	100	B	19
I4	T1	0	0	5	95	B	21
	T2	0	0	79	21	A	20
C1	T1	0	0	6	94	B	21
	T2	0	0	6	94	B	28
C2	T1	77	2	21	0	G	20
	T2	97	0	3	0	G	17
C3	T1	0	0	95	5	A	22
	T2	0	0	100	0	A	22
C4	T1	1	43	2	54	B	10
	T2	0	5	4	91	B	14

Participant I1 was assigned to pattern B, and this assignment remained almost unchanged after the intervention, with her stress level even increasing post-intervention. In her intervention reflection, the participant states that she suffers from a personality disorder and experiences mental health challenges. Despite this, she evaluates the sessions positively: "The seminars made me reflect on myself in certain ways. They guided me a bit toward a path of self-acceptance, and above all, I'm now trying to look at some things a little differently." She states that she found the mindfulness exercises "particularly helpful." Although they caused discomfort at the beginning—and this still happens occasionally—she uses these exercises to manage her emotional fluctuations, as they help her maintain distance from intense emotions and avoid reacting too quickly without consideration.

Participant I2 was initially assigned to pattern A, with a shift toward pattern G after the intervention. His stress level also tended to decrease post-intervention. The participant evaluated the sessions positively, describing them as "a very pleasantly spent time with reflection." At the same time, he admitted to having mixed feelings about the "exercises with a negative connotation," which felt uncomfortable at first because he "is used to thinking positively." In the end, however, he acknowledged that learning to deal with negative matters is important and said he was glad he went ahead with it.

Participant I3 was initially assigned to pattern B, with only minimal change post-intervention. However, he himself recognizes even this slight shift toward pattern S and "considers it a step toward better stress management and personal balance." His stress level decreased notably after the intervention, which he views as significant personal progress and attributes primarily to the mindfulness exercises: "The practical grounding in the present moment without judgment was a new experience for me—one that has a concrete impact on my everyday life. Since I

often struggle with feelings of anxiety and performance pressure, mindfulness has become a technique I actively use to reduce stress and to stay more connected with my own experience.” In addition, he highlights the value-oriented exercises, noting that he appreciated the opportunity to reflect on his core values as well as on those he currently pays less attention to but believes deserve greater focus.

Participant I4 was initially assigned to pattern B with a full pattern expression (more than 95% concordance), followed by a post-intervention shift to pattern A. His stress level showed only a slight decrease. The participant acknowledges this shift and explains that, although he remains in a risk pattern, he perceives that post-intervention he “feels more able to fulfil his potential,” which motivates him to continue improving. He attributes this change mainly to the mindfulness exercises and noted that after the in-class sessions he felt more relaxed, with an improved mood that lasted throughout the day. He reports that he has learned to use these exercises at home whenever he feels that he cannot keep up or struggles to manage everything.

With regard to participants in the control group, who were not exposed to the intervention, no pattern shifts occurred. Regarding stress levels, for participants C1 and C4, who were assigned to (and remained in) pattern B, stress levels tended to increase. Specifically, in participant C4, the level of concordance with pattern B also tended to increase notably from T1 to T2. For A-type participant C3, stress levels remained stable, and for G-type participant C2, there was a tendency for stress levels to decrease.

5 Discussion

This study presents a pilot evaluation of a six-week ACT-based intervention with an emphasized mindfulness component, focusing on its effects on psychological vulnerability—operationalized as assignment to risk work-related patterns—and perceived stress in university students. Pre- and post-intervention data indicated pattern shifts in two of the four participants. One participant shifted from risk pattern A to the healthy pattern G, accompanied by a reduction in stress of approximately six points. A second participant shifted from pattern B to pattern A, with a reduction in stress of about one point. Although this latter change represented a transition between two risk patterns and involved only minimal stress reduction, it was nevertheless considered a favorable outcome, as pattern A is generally regarded as less problematic than pattern B, which is associated with predominantly negative correlates (e.g. Kieschke & Schaarschmidt, 2008). This shift may therefore be interpreted as an initial step toward healthier patterns, a view supported by the participant’s expressed motivation to continue improving. In addition, the relative stability of stress levels may be viewed positively, given that the intervention coincided with the onset of the examination period, an inherently stressful time for students. In the remaining two participants, no pattern changes were observed. However, one student, who remained in pattern B, showed the largest reduction in stress, with a decrease of approximately nine points. The only participant for whom no positive quantifiable outcomes were observed was a student, who showed a stable, very high level of concordance with pattern B at both pre- and post-intervention, accompanied by an increase in stress levels. Notably, this participant had been diagnosed with a personality disorder and reported persistent mental health challenges, which are unlikely to be substantially affected by a six-week intervention. Nevertheless, the participant reported perceived subjective benefits from the intervention, which may be valuable when combined with ongoing professional treatment. In contrast, none of the four students who were not exposed to the intervention showed a pattern shift. Unsurprisingly, two students classified as pattern B also experienced an increase in stress levels, likely associated with the examination period. For the student classified as pattern A, stress levels remained unchanged, whereas, interestingly, the student classified as pattern G showed a decrease in stress. This finding points to the self-regulatory nature of pattern G, which allows for spontaneous improvement—an outcome that would

be highly unlikely in the case of risk patterns (Schaarschmidt, 2005).

From the participants’ perspective, the intervention was evaluated very positively, particularly with regard to its perceived usefulness and transferability to everyday functioning, with mindfulness exercises identified as the most salient component and associated with both subjective benefits and observable improvements. Consistent with these experiences, a meta-analysis of interventions in university students reported stronger effects of mindfulness-based programs than ACT on anxiety and depression outcomes (Ma et al., 2022). Similarly, mindfulness-based interventions have been shown to produce more rapid reductions in depressive symptoms than ACT, although comparable effects may emerge over longer periods (Sadeghi-Bahmani et al., 2022). Together, these findings suggest that mindfulness exercises may be experienced as more tangible and immediately effective, whereas ACT-based exercises may exert more subtle or gradual effects that are less readily recognized in short-term interventions.

The results of this study should be regarded as preliminary, primarily due to the small, non-randomized convenience sample. Nevertheless, they point to important directions for future research using more robust methodologies. Further evaluation of the program is warranted, ideally by examining its individual components separately as well as in combination and by including an appropriate control group. Adding a follow-up measurement point would also allow the assessment of cumulative and longer-term effects of the program components. Importantly, the preliminary findings suggest that the intervention may reduce psychological vulnerability and stress in high-stress, non-clinical populations, but is not primarily intended for clinical populations, although individuals with clinical conditions may still experience subjective benefits.

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WILLINGNESS OF STUDENTS IN QUALIFICATION STUDIES TO APPLY THEORETICAL REQUIREMENTS ACQUIRED THROUGH EDUCATION IN THEIR PRACTICE

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This paper is part of the KEGA 013TUKE-4/2023 project Creation and innovation of university and lifelong education in study field 'transport' according to the development of digital and practical skills

Abstract: The paper presents the results of the analysis of the work students studying in qualification education at the field of didactics of vocational subjects. The question of a person's willingness to act in accordance with the declared theoretical requirements, e.g. in the field of their professional focus, is one of the important prerequisites of critical thinking and its application in their actions. It concerns every person in connection with their critical thinking and especially teachers, as they are required to teach their students to think critically. The results of the study point to a low willingness to consistently apply theoretical principles – only in 38% of cases – to their practical activities. A positive step could be greater support for the formulation of the teaching intention in the lesson, through its direct orientation to the content of the curriculum in relation to the consistent formulation of specific objectives.

Keywords: critical thinking, willingness, teaching intention, teaching objectives, teacher's test

Introduction

The need to develop critical thinking in students is highly relevant in today's age of information overload. It is one of the key competencies of a person, yet in our country, its low level has been consistently demonstrated in several international tests. In Slovak State Educational Programmes, critical thinking is mentioned specifically in connection with digital and technological competencies. However, it is generally applied in the functioning of individuals in their professional and private lives. One of the prerequisites for the use of critical thinking is a person's willingness to act in accordance with the theoretical requirements they have acquired or to step outside their routine way of dealing with situations.

The aim of this paper is to present the results of an analysis of selected ongoing assignments completed by students within the framework of qualifying education, specifically in supplementary pedagogical studies. The analysis focuses on determining how students demonstrate the use of acquired knowledge in subsequent practical application. This involves a willingness to consistently use specific teaching objectives when creating test questions to verify the knowledge acquired from a thematic unit in the form of test tasks, which are to be part of a task bank to illustrate the process of compiling a teacher's test. The results obtained are evaluated quantitatively using simple statistics, and problematic solutions are analyzed by description.

1 Defining contexts in educational activities aimed at verifying the results achieved during education

The educational process is a purposeful activity that develops a person intellectually, emotionally, volitionally, and physically (1, p. 43). We define the content of the curriculum for the educational process using didactic analysis of the curriculum. One of its results is the formulation of specific teaching objectives (2). The concept of teaching objectives has been mapped in the work of several authors by Istvan (1, p. 22-39), who gives the most common definition of an objective as "an ideal idea of what is to be achieved through educational activities" (1, p. 22). The effectiveness of the educational process can be determined by verifying the degree to which the set teaching objectives for a lesson or teaching unit, i.e., specific teaching objectives, have been achieved.

The results of educational activities can be demonstrated in writing, orally, or practically. In formal education, this is defined

by the methodological guidelines for the assessment and classification of secondary school students (3, p 3). These are natural methods of assessment that can also be used in informal education. In any case, it is a comparison of the achieved state with the ideal idea of what the final state should be after the education has been completed, or with what is expected from the education.

1.1 Lifelong learning

The lifelong learning system under the Adult Education Act (292/2024) consists of formal and non-formal education and informal learning by the learner. Formal education is education and training in a school that is part of the network of schools and educational institutions of the Slovak Republic. It also includes study in a study program at a university. Education in an accredited educational program is also formal education under the provisions of this Act (4).

Informal learning is an educational process that takes place according to planned activities, outside of those that fall under formal education, for the purpose of acquiring, supplementing, expanding, or deepening qualifications, key competencies, or basic, digital, or green skills. In both formal and informal education, it is necessary to demonstrate the results achieved through educational activities.

1.2 Education to obtain the qualifications required to perform the work of a teaching employee

The Act on Pedagogical Employees and Professional Employees (138/2019) addresses, among other things, the issue of professional development (§ 40). As part of this, it also deals with the acquisition of education to meet the qualification requirements of pedagogical and professional employees, one of which is qualification education (§ 42). Its aim is to acquire education through which a pedagogical employee and professional employee at the relevant level of required education will acquire the qualification requirement for performing work activities in the relevant category and subcategory (§ 43); we will focus on the category of teacher and the subcategory of secondary school teacher (upper secondary level) (5). Such qualification education is supplementary pedagogical studies (§ 44) (6). As part of qualification education, it is also necessary to demonstrate the achieved results of educational activities.

In the case of the performance of the work of a pedagogical employee, the evaluation of the performance of pupils is an integral part of his work. The subject of the evaluation is the level of knowledge and skills, according to the currently valid curricula and educational standards (7, § 9), that the pupil has achieved through education (3, p. 2). According to the professional standard of a beginning pedagogical employee, a secondary school teacher must have the competence to "evaluate the course and results of the educational process and a beginning pedagogical employee is capable of evaluating the fulfillment of the objectives of the educational process" (5).

1.3 Demonstrating the achievement of educational outcomes

A common element of the above-mentioned processes is, among other things, the verification of acquired knowledge. In both cases, these are educational processes; their task is to provide participants with the opportunity to acquire new knowledge, skills, and habits. For education to be effective, it is necessary to have appropriately set goals, which the teaching is geared towards achieving (8, p. 52). Verifying acquired knowledge is a way of checking whether specific goals have been achieved in the relevant teaching units.

However, it is also important in this case study that participants in qualifying education (supplementary pedagogical studies) will

in future be compulsory to verify the results of their educational activities in the course of their professional work, whether teaching pupils in formal education or lecturing adults in lifelong learning.

1.4 The position of critical thinking in contemporary education

Critical thinking is one of the key competencies. It is essential to develop it across all levels of education. Although critical thinking is not directly mentioned in the list of key competences within the European Reference Framework (9), it is specifically included in the key competences in State Educational Programmes of the Slovak Republic. The wording depends on the effective date of the Slovak State Educational Programme. In their versions valid from September 1, 2013, to August 31, 2022, it is mentioned in connection with the ability to interactively use knowledge, information and communication technologies, and communicate in the mother tongue and foreign languages (10, p. 56). In the amendments to the Slovak State Education Programs through addenda, valid from September 1, 2022, it is stated in connection with digital competences (12, p. 5). The innovated Slovak State Education Programs, valid from September 1, 2025, also mentions critical thinking with digital competences (12, p. 7). In this work, we use the example of a specific State Education Program for the field of study and training 26 Electrical Engineering, while in the Slovak State Education Programs of other fields, the issue of critical thinking is addressed analogously.

The application of critical thinking is linked to the willingness of those involved to take appropriate action. Willingness is a variable that influences a person's level of critical thinking (13, p. 290).

2 Examining the application of students' acquired knowledge in supplementary pedagogical studies

Among other things, supplementary pedagogical studies provide students with an opportunity to acquire knowledge and skills for effective lesson planning. Emphasis is placed on working with specific teaching objectives, understanding their significance, learning how to formulate them correctly, and using them in the process of verifying the effectiveness of the teaching process.

Upon completion of courses in general pedagogical and psychological subjects in the first year of supplementary pedagogical studies, students are expected to understand the role and functions of the hierarchy of educational goals in the education system, can correctly formulate specific objectives for a lesson/unit, understands the role and correctly applies the taxonomy of cognitive specific objectives.

2.1 Subject and methodology of study

The subject of the study, the results of which we present here, is the identification of formulation of specific objectives in the creation of tasks for testing acquired knowledge for a bank of tasks for a potential teacher test. We were interested in whether, and how consistently, specific objectives were formulated by students in this context. The study was conducted in October and November 2025. There was analysed the ongoing assignments of second-year students in a supplementary pedagogical study program. We analysed 45 solutions twice, which were the output of two phases of teaching in a subject in the field of subject didactics for vocational subjects with a technical and economic focus at secondary vocational schools. The students of the supplementary pedagogical study program are graduates – they are in their subsequent studies, and full-time second-degree students – they are in their concurrent studies, university studies of a technical or economic focus in accordance with the conditions of approved study programs of Supplementary Pedagogical Studies at the Technical University of Košice. The study program is two years long, and the students in this case study already have completed the first year, which provides a theoretical pedagogical-psychological-didactic foundation for

application in the subject didactics of professional subjects, which is part of the second-year curriculum.

The requirement for the preparation of the interim student work in the first phase was, for the selected vocational field of study and within it for the selected subject at a secondary vocational school in their field of university study at the engineering level, select a thematic unit and create six test questions to verify the knowledge and skills acquired by pupils in this thematic unit. Students were to build on theoretical foundations, the practical application of which was discussed many times during their studies in connection with solving various model situations and completing part of their teaching practice. The task served during the following block of teaching to illustrate the application of rules for creating teacher tests in vocational subjects. The emphasis was placed on the task of verifying the degree to which specific objectives had been achieved and on the method of implementation in a teacher test (14, p. 19), focusing on a cognitive, non-standardized, monothematic test verifying the results of teaching (15, p. 111), including the function of a specification table in construction of the test (15, p. 113). Students then had the option, but not the obligation, to revise their interim student work in the second stage based on the completed instructions and submit it for assessment within 12 days. In the Moodle information system, which is used to upload electronic versions of student work, it was specified that the revision of the solution consisted of adding specific objectives. The revised student solutions served as data for the evaluation of our study.

2.2 Results of the study

The students prepared their interim student work in the first stage in such a way that one of the results was the formulation of the required six test tasks/questions to verify the knowledge and skills acquired by the pupils from the selected thematic unit. Without a clearly expressed requirement to formulate specific objectives, the achievement of which would be verified by the test questions, none of the 45 students dealt with specific objectives in connection with the process of formulating test questions. Thus, without direct requirement, no student was neither able nor willing to apply the theoretical knowledge about the role of specific goals in the process of verifying the results of the teaching process, which was taught during the first year of supplementary pedagogical studies.

A simplified view of the results of the second stage of the study is illustrated in the last column of Table 1. It shows that even after completing a block of the instructions in which the role of specific objectives in the construction of a teacher's test was demonstrated, and despite the exact requirements in the task description in Moodle, only slightly more than a third of students formulated the corresponding testable cognitive specific objectives in the correct form, using active (action) verbs, with classification into the required taxonomy, in this case Niemierko's taxonomy. Almost a third of the solutions still did not include the required specific objectives.

Table 1: Quantitative expression of the occurrence of the monitored phenomenon – formulation of specific objectives in the creation of test tasks

Specific objectives formulated	Number of students in study					
	graduates – subsequent		full time – concurrent		in total	
	number	%	number	%	number	%
correctly	10	36	7	41	17	38
missing	11	39	2	12	13	29
incorrect. / incomplet.	7	25	8	47	15	33
In total	28	100	17	100	45	100

Source: Own research

Table 1 in the other columns provides a more detailed overview. It divides the responses into two categories: participants in

continuing education, i.e., graduates of higher education, and participants in concurrent education, i.e., full-time students in higher education. Students in concurrent education showed a greater willingness (approximately 15%) to accept the requirement to work with specific objectives in relation to the creation of test tasks.

A detailed analysis of the students' ongoing work yielded the following key findings: one student did not submit a revised solution, and their first version did not include specific objectives for the test questions they had created, and the solution also contained other fundamental errors. The most common errors in incorrectly or incompletely formulated cognitive specific objectives were:

- active verbs are not used correctly or consistently; expressions such as "understands", "remembers", "knows the principles", "comprehends", "knows the designation", "understands the function", "comprehends the function";
- cumulating of several specific objectives in such a way that one is stated with a more complicated expression; although all specific objectives identified as separate in this combined whole are at the same level of taxonomy;
- cumulating several specific objectives into the formulation of one specific objective, while the individual ones are at different levels of taxonomy, e.g. "name and describe", "can justify... and give specific examples...", "identify and list", "define the concept... and recognize its basic attributes...", "define... and explain their use", "can use – can explain". The required classification of specific objectives within the taxonomy is missing;
- excessive focus on test questions rather than to acquired knowledge when formulating specific objectives; e.g., part of the formulation of specific objectives was in the form: "will remember and fill in the missing term in the definition...", "the pupil will select the correct factors..." (from a selection in a multiple-choice test question – one correct answer), "the pupil will correctly assign...";
- a tendency to formulate specific objectives tailored to test questions, (rather than the other way around, i.e., to create appropriate test tasks based on specific objectives); this situation probably arose among those students who were only interested in fulfilling the requirement to complete the second stage of the specified solution, without accepting the broader necessary context. The questions are supplemented (during the revision of the solution in the second stage) with analyses that contain specific objectives, but are formulated in an excessively extensive and descriptive manner, which greatly reduces the clarity of their expression;
- an analysis of the questions has been created, including their classification in the taxonomy, but specific objectives are not directly formulated – the analysis is less precise, less clear, and more difficult to directly orientate oneself in the problem;
- test questions are classified in the taxonomy without indication of the specific objectives they test;
- replacement of a specific objective directly with a test question.

In the event of incorrect formulation of specific objectives, mainly by combining several into one objective, a proposal is usually made to assign a number of points from a range, without perceiving the connection between the weight of valuation and the cognitive difficulty of the specific objective being verified.

Conclusion

The article presents the results of research based on the analysis of ongoing student assignments on the topic of creating tasks to verify acquired knowledge for a task bank to illustrate the process of compiling a teacher's test. The findings indicate that despite the opportunity to correct solutions that did not originally include specific objectives, especially cognitive ones, as required for the correct and effective formulation of test tasks to verify the knowledge acquired from a given subject area, the resulting solutions in the second phase are correct only in the case of 38%

of students, and 29% of students did not show a willingness to include specific objectives in the recommended form in their solutions. 33% of students were unable to apply the theoretical rules for formulating specific objectives correctly, despite having completed the relevant training.

Enhanced support for the formulation of lesson intentions at the lesson level may constitute a step towards achieving positive outcomes for teachers by mediating between a direct orientation towards curriculum content and the systematic formulation of specific objectives.

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WORK-RELATED COPING BEHAVIOR AND EXPERIENCE PATTERNS AND THEIR CORRELATES IN TEACHER EDUCATION STUDENTS: A QUALITATIVE STUDY

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Abstract: This qualitative study explores how Czech teacher education students with a high match to one of the four Work-Related Coping Behavior and Experience Patterns perceive their academic success, academic self-concept, and academic self-efficacy. Using semi-structured interviews with six prototypical representatives of patterns G, S, A, and B, the findings reveal distinct profiles consistent with previous quantitative research while adding nuanced insights, particularly regarding the challenges associated with the risk patterns A and B. The study provides preliminary evidence that enriches understanding of the nature of these patterns and their academic correlates, offering implications for teacher education and student support.

Keywords: occupational vulnerability, teacher education, academic functioning

1 Introduction

Teachers play a vital role in shaping individuals and society, yet even before entering the profession many education students experience considerable psychological vulnerability (Mašková, 2023). These difficulties may later translate into occupational health problems, affecting both their well-being and future professional functioning. This underscores the need to understand and address such risks already during teacher education.

1.1 Work-related coping behavior and experience patterns

The concept of Work-related Coping Behavior and Experience Patterns is assessed using the homonymous diagnostic inventory—the *Arbeitsbezogenes Verhaltens- und Erlebensmuster* (in German; Schaaerschmidt & Fischer, 2008). The 66-item AVEM measures 11 dimensions across three domains (professional commitment, coping capacity, subjective well-being) and classifies respondents into one of four empirically derived work-related patterns. These patterns reflect health-relevant constellations of motivation, coping resources, and emotional functioning. Overall, it enables early identification of individuals at increased risk (patterns A and B) and helps target preventive interventions before health problems fully develop (Kieschke & Schaaerschmidt, 2008; Schaaerschmidt & Fischer, 2008). The characteristics of the four work-related patterns are as follows: (1) Pattern G (Healthy Ambitious): A health-promoting profile characterized by high but balanced professional commitment, strong coping resources, and high subjective well-being. Individuals can engage deeply in work while maintaining emotional distance and resilience. (2) Pattern S (Unambitious): Marked by low professional commitment and reduced work investment, but with adequate coping capacity and high well-being. Although health is not at risk, motivation tends to be low, and engagement is minimal. This pattern may act as an energy-saving strategy under stressful conditions. (3) Pattern A (Excessively Ambitious): Defined by very high commitment (strong ambition, perfectionism, overexertion) combined with weak coping resources and limited emotional detachment. Individuals experience high strain and low emotional reward, which increases vulnerability to stress-related health problems. (4) Pattern B (Resigned): The least favorable profile, combining low professional commitment with very low coping capacity and poor well-being. It mirrors core features of burnout—exhaustion, negative emotions, and withdrawal—and signals heightened long-term vulnerability to occupational health issues.

1.2 Correlates of work-related patterns in university students

Studies utilizing the AVEM inventory in university student populations—conducted mainly in German-speaking countries—have identified several correlates of the distinct work-related patterns. The results of the published studies consistently show that female students, teacher education students (compared to medical students), and students who receive insufficient social and financial support are at greater risk of being assigned to work-related patterns that indicate vulnerability to burnout and occupational health issues. Moreover, students assigned to these patterns, especially to the resigned (burnout) pattern, are prone to manifest other negative characteristics, such as less adaptive personality traits and coping strategies, vulnerability to stress, lower quality motivation, lack of commitment to the chosen career and suitability for the profession, and impaired physical and mental health. In contrast, the most desirable correlates—such as adaptive personality traits, higher quality motivation, commitment to the chosen career, suitability for the profession, stress resistance, adaptive coping, and better physical and mental health—were related to the healthy ambitious pattern G (Mašková, 2023).

Although topics such as motivation and mental health have been studied extensively, evidence on academic functioning—including academic self-concept, self-efficacy, and perceived success—remains limited. The available findings for students, including teacher education students, suggest a varied set of findings. Self-perceived academic achievement appears to be highest in G and A types (Aster-Schenck et al., 2010; Voltmer et al., 2012), and these groups also report the greatest perceived success during teaching placements (Cramer, 2012). In contrast, expected placement success tends to be higher among G and S types than among A- and B-type students (Cramer, 2012). Similarly, expected future career success is highest in G-type students and lowest in B-type students (Rothland, 2011). Consistent with these trends, self-efficacy is higher in G and S types compared to A and B types (Bauer, 2009). Overall, these findings show a mixed pattern that warrants deeper and more systematic investigation.

1.3 Academic self-concept and self-efficacy

Academic self-concept refers to students' subjective perceptions, beliefs, and knowledge about themselves in academic situations, including the abilities, attributes, and limitations they consider part of their identity (Ferla et al., 2009; Ghazvini, 2011). These beliefs play an important developmental role, shaping cognitive, social, and emotional engagement (Bong & Skaalvik, 2003). Although related to self-efficacy, the two constructs differ. Academic self-concept has both cognitive and affective components, concerns general abilities, is shaped by past experiences and social feedback, and focuses on whether one possesses certain competencies. Self-efficacy is primarily cognitive, task-specific, future-oriented, and reflects beliefs about what one can accomplish with a given ability. It is formed through previous performance, comparison with others, and verbal persuasion, particularly when delivered by trusted sources (Bong & Skaalvik, 2003; Ferla et al., 2009).

2 The present study

Work-related patterns in teacher education students have been widely studied quantitatively using the AVEM, yet no qualitative research exists. This gap limits deeper insight into the characteristics and experiences associated with each pattern. The present study addresses this gap by using semi-structured interviews to examine how students with a high match to one of the four work-related patterns describe their academic functioning, focusing specifically on perceived academic

success, academic self-concept, and academic self-efficacy. The study is guided by two research questions:

RQ1: What manifestations of perceived academic success can be observed among individuals with a high match to each work-related pattern?

RQ2: What manifestations of academic self-concept and self-efficacy can be observed among individuals with a high match to each work-related pattern?

3 Method

3.1 Participants

Participants were selected through purposive sampling from teacher education students who had previously consented to further contact during a first-year quantitative survey. From this pool, we invited those whose work-related patterns showed over 95% pattern concordance—considered prototypical representatives of each pattern (Schaarschmidt & Fischer, 2008)—and who agreed to participate. Six students took part, all of them women aged 20 years. Participant characteristics are presented in Table 1.

Table 1: Participant Characteristics

Respondent	Year of study	Specialization	Pattern	Level of concordance
G1	2	Art and Chemistry for LSS	G	99.33%
G2	2	Art and Russian for LSS	G	97.51%
S1	1	English and Spanish for USS	S	98.69%
S2	1	English and Spanish for USS	S	98.94%
A1	2	Czech and History for LSS	A	95.85%
B1	1	English and Czech for USS	B	99.99%

Note. LSS = lower secondary school, USS = upper secondary school.

3.2 Procedure

Data were collected through semi-structured interviews, allowing coverage of key topics while remaining flexible to participants' responses. Interviews were conducted in a quiet private space at the university, lasted approximately 45 minutes, and were audio-recorded. Recordings were transcribed verbatim for analysis, and to ensure anonymity, neither the audio files nor full transcripts are publicly accessible. Prior to participation, all participants received detailed information about the aims of the study, the voluntary nature of participation, data handling procedures, and their right to withdraw at any time without consequences. Written informed consent was obtained from all participants before data collection. Each participant received a one-time stipend of 500 CZK as compensation for taking part in the interview.

3.3 Data analysis

Data were analyzed using deductive thematic analysis following the six-step procedure described by Braun and Clarke (2006). After repeated reading of the transcripts, semantic codes were generated to capture explicitly stated meanings. These codes were then grouped into themes informed by the research questions and the existing theoretical framework on work-related patterns. Themes were reviewed against the coded data and the full dataset, refined for coherence, and clearly defined. Credibility was enhanced not only through careful purposive sampling of prototypical participants with high pattern concordance and the use of direct verbatim quotations, but also through peer reflection and collegial discussion throughout the

analytic process. Transferability was addressed by systematically comparing the qualitative findings with existing results. This allows readers to assess the potential applicability of the findings to similar contexts. Dependability was ensured through the use of a consistent interview guide across all participants, verbatim transcription of audio recordings, and re-coding of the data, allowing for transparency and traceability of analytic decisions throughout the research process.

4 Results

4.1 Perceived academic success

G-type students define academic success more broadly than achieving good grades, passing examinations, or completing the semester without complications. They also emphasize meeting self-set goals, acquiring new knowledge, consolidating previously learned material, and experiencing enjoyment during their studies. These indicators are not explicitly required by the university, suggesting that G-type students establish their own additional criteria for what constitutes success. G-type students include experiences of enjoyment and personal growth within their definition of academic success. As one student noted, "We have sculpture class, which is something I had never done before, and I found out that I actually enjoy it. I'm really satisfied with what I created there." (G1). They also describe setbacks such as receiving lower grades, perceiving weaker performance compared to peers, or feeling they have acquired less knowledge than others. As another respondent explained, "It's definitely quite difficult to see your classmates manage something while you notice you still have some gaps." (G2). These setbacks are typically interpreted as minor, correctable issues or as opportunities for learning and improvement. As one G-type student put it, "I tell myself that I need to try harder next time. And if it's a test I have to retake, I just spend more time preparing for it." (G1).

For S-type students, academic success is described primarily in terms of acquiring new knowledge, passing examinations, submitting seminar papers on time, and being accepted into the Erasmus program. One participant stated, "I successfully completed my seminar paper on [...], and now in the first semester I managed everything on the first attempt." (S1). The only setback mentioned by S-type students was the failure to meet self-imposed goals. When experiencing such a setback, they tend to evaluate the issue and formulate a revised plan for future action. As one informant explained, "I made a resolution to work on English transcription because I'm not good at it and haven't done it yet. So that's a kind of failure, because I set it as a goal and still haven't done it." (S2).

The A-type student reported only experiences of success. She considered success not only the completion of all examinations but also the fact that she passed each of them on the first attempt. She stated that she has not encountered any setbacks so far. However, she acknowledged that these achievements came at the expense of her personal life, as she dedicated the entire semester solely to studying. As she noted, "I think so far it's only been successes. Even though it takes a lot of effort and I really have to study hard, I still see only success at this point." (A1).

The B-type participant described academic success primarily as completing most courses despite periods of demotivation and procrastination. As she noted, "I passed, and I didn't get any barely-passing grades. So, in the end I somehow learned it." (B1). In terms of setbacks, she mentioned missing an exam session and failing a course she had considered easy, which led her to underestimate the preparation required. "To be specific, I didn't attend the exam for one course. I went to the first attempt and failed. For personal reasons I couldn't make it to the second, so I basically let it go. I'll have to retake the course in the second year." (B1). She did not feel the need to cope with these setbacks or propose any preventive strategies. Although the failure did not weigh heavily on her, it did elicit a sense of personal disappointment. As she explained, "It didn't really weigh on me. I just thought it was annoying that I'd have to repeat it. I was a

bit disappointed with myself because I assumed it would be an easy course." (B1).

4.2 Academic self-concept and self-efficacy

G-type students believe they plan their time more effectively than others and possess greater knowledge or experience in certain areas. They also view themselves as more motivated, diligent, eager to learn, and disciplined. Additional strengths mentioned include their extraverted disposition, positive attitude, and ability to work well with children. As one student noted, "I attended art classes at the arts school from the first grade until the end of high school, so when a teacher mentions certain techniques, I already know them." (G2). Their main perceived weakness is a reduced ability to explain subject matter to children. As one respondent stated, "I can't always express myself precisely, so I'd worry that the children might not fully understand me." (G1). Although they recognize that university provides limited opportunities to make a strong impression on instructors, they still believe they create a generally positive image—one of effort, diligence, and consistent attendance. As one of them explained, "I hope they see me positively, as someone who really works hard and tries to manage everything." (G2). Regarding peers, they hope to be perceived as extraverted and hardworking, and potentially as competitors. As one student remarked, "I see them as competitors, and they might see me as competition too. But I think it definitely motivates us." (G2).

S-type students view their main strengths—relative to their peers—as the ability to create an effective study plan, thorough preparation for classes, specific knowledge and experience, adaptability, diligence, in-class engagement, willingness to help others, higher creativity, and a modern approach to teaching. As one student noted, "I did much better in languages than most of my classmates." (S1). Another commented, "I think planning is where I stand out; when I watch my classmates, I notice that I plan things much more." (S2). Their perceived weaknesses include a lower ability to explain subject matter clearly, as well as insufficient assertiveness and authority. As one participant stated, "Explaining things is something I'm not very good at." (S2). They believe that both teachers and peers generally perceive them positively—teachers focus more on their classroom engagement, while peers notice their helpfulness. According to one student, teachers likely see them as active and responsible: "As a good student. Because I'm active in class, I try to maintain the best possible relationships with my teachers." (S1). Peers, in their view, recognize their helpfulness, self-improvement efforts, and occasional tendency to procrastinate. As one participant explained, "They already know about my procrastination—it's not ideal, but otherwise things are fine." (S1). Another added, "I think they know I'm happy to help, that I help my classmate with Spanish a lot because she hasn't studied it very long, so she's not afraid to reach out to me." (S2).

The A-type participant reports both positive and negative aspects of her self-perception, with a slightly stronger emphasis on the negative. She believes she is more diligent and hardworking than others, yet she often feels out of place, alienated, and inadequate. She experiences the university environment as lacking close connections and perceives little interpersonal interest from others. As she explained, "I feel like I don't really have many people there to talk to, so I feel kind of alienated, and it always seems like I just go there to sit through things, but the actual contact with people isn't really there." She thinks instructors see her in class as diligent and responsible, or simply as unremarkable and average. During oral examinations, however, she tends to become stressed and assumes that teachers subsequently view her as someone who crams, learns things by rote, or fails to prepare adequately. As she put it, "I always give it my maximum, but then stress gets to me, and I end up saying things I know are wrong—things I'd never normally say. And then I think teachers see me as someone who either memorizes everything or didn't prepare properly." In her view, classmates tend to perceive her as very intelligent, but they attribute her performance to innate abilities rather than effort. As a result, she sometimes senses envy from peers and feels they may view her

as competition. She also thinks they assume she cares only about her studies. As she noted, "There's a bit of envy and a bit of sniping, but no one sees what's behind it—that I actually prepared, and they didn't."

The B-type participant perceives herself predominantly negatively in comparison with others. She reports tendencies toward procrastination, neglecting responsibilities, poor memory, weak explanatory skills, disorganization, laziness, low performance, and ineffective planning. At the same time, she believes she has stronger knowledge and experience in English and that she can be more understanding and empathetic than others. She would like to develop more effective study techniques and improve her time management in the future. As she explained, "I have this unpredictable memory—sometimes I can recite an entire text word for word, and other times I can't recall anything." She also described herself as "a messy student, maybe even a lazy student. I guess I'm pretty lucky that even when I ignore things, they somehow end up working out." Her negative self-perception extends to how she believes she is viewed by teachers and peers. She thinks teachers mostly do not notice her, and if they do, they see effort and unrealized potential. As she stated, "I don't think many teachers pay attention to me." In her view, peers perceive her as unremarkable, quiet, and unfriendly. As she recalled, "I was told that I have a look as if I wanted to kill someone."

5 Discussion

This study aimed at deepening our knowledge on the correlates of work-related patterns assessed by the AVEM inventory in Czech teacher education students, employing a qualitative approach and focusing on less-researched topics related to academic functioning. With respect to the perceived academic success, the broadest range of academic successes was reported by G-type students. These successes reflect not only academic performance or criteria implicitly associated with being a "good student," but also the fulfilment of personal aims and self-defined goals. Although they do report setbacks, G-type students tend to downplay them and treat them primarily as opportunities for future learning. S-type students also report mainly successes, though with less variety, focusing more strongly on academic performance and the fulfilment of standard "good student" criteria. Nevertheless, when setbacks occur, they are interpreted similarly to those in the G pattern—as chances to learn from mistakes and to improve. The A-type student described her study experience as consisting solely of successes related to academic performance and the fulfilment of standard "good student" criteria. However, these achievements appeared to be attained through substantial effort at the expense of her personal life. For the B-type student, academic success was defined as fulfilling academic obligations without being at the edge of failing to meet them. She focused more on setbacks than on achievements, and these setbacks tended to reinforce her already negative self-perception rather than motivating preventive or strategic efforts.

With respect to academic self-concept and academic self-efficacy, both G-type and S-type students show generally positive self-perceptions and readily identify their strengths, while sharing the same perceived weakness in explaining subject matter. They also expect teachers to view them favorably. The main difference lies in peer perceptions: G-type students anticipate mostly positive evaluations, whereas S-type students expect a more ambivalent view—being seen as supportive but also associated with negative traits such as procrastination. The A-type student's self-perception is more ambivalent: although she recognizes certain strengths, these tend to be overshadowed by persistent feelings of inadequacy and alienation. Her expectations regarding how teachers and peers perceive her are similarly mixed, marked by negative undertones. She assumes teachers may interpret her stress-induced performance as incompetence, and she feels peers misunderstand her efforts—perceiving her achievements as innate rather than earned, which contributes to a sense of interpersonal misalignment. The B-type student perceives herself predominantly negatively, focusing mainly on her shortcomings. Her expectations of how teachers

and peers view her also carry a negative undertone—either assuming she is not noticed at all or that she is perceived in an unfavorable light.

The findings of the present study go beyond the quantified results reported by previous authors on academic functioning. While both A- and G-type students typically score high on perceived achievement (Aster-Schenck et al., 2010; Cramer, 2012; Voltmer et al., 2012), our results show that their subjective experience of success differs markedly, especially when comparing G- and A-type students. Although the A-type student reported no failures—which may indeed suggest a high level of success—our findings show that this picture is far less glorious than quantitative studies might imply, as such success comes at the substantial cost of sacrificing their personal life. This study also confirmed what previous qualitative findings have suggested—namely, that G- and S-type students show better success expectations and higher self-efficacy than A- and B-type students (Bauer, 2019; Cramer, 2012; Rothland, 2011). Our results not only support the more positive future outlook of G- and S-type students but also reveal a more positive present self-view in the context of their academic studies. At the same time, the study offers a more nuanced understanding of pattern A, revealing its inherently ambivalent character in contrast to the clearly negative profile of pattern B—an insight that would remain hidden if only quantitative data were considered. In conclusion, this study offers a valuable contribution with both theoretical and practical implications.

The main limitation of this study is the small research sample. In both risk patterns, only one participant was included due to limited willingness among these students to take part in the interview. Moreover, the participants differed in their year of study, so for second-year students more time had passed since the first-year AVEM survey, making shifts in pattern assignment possible. Given these limitations, the findings should be viewed as preliminary and as providing initial input for future qualitative studies on this topic.

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Primary Paper Section: A

Secondary Paper Section: AN, AM

THE FAMILY ENVIRONMENT OF A CHILD WITH ADHD

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Abstract: Raising a child with Attention-Deficit/Hyperactivity Disorder (ADHD) represents a long-term and complex burden for families, significantly affecting parental mental health, family functioning, and daily parent-child interactions. The aim of this review article is to summarize current research findings on the family environment of children with ADHD, with a particular focus on parenting stress, parental mental health, and quality of life. The paper draws on recent quantitative and qualitative studies conducted across diverse cultural contexts and examines both risk and protective factors related to parents and the broader social environment. Special attention is paid to gender differences in caregiving burden, the impact of the COVID-19 pandemic, and the role of socioeconomic conditions. Furthermore, the article reviews intervention approaches targeting parents and families, including mindfulness-based programs, art therapy, family- and narrative-based interventions, group programs, and telehealth modalities. The reviewed evidence consistently indicates that targeted parental support is a crucial component of effective ADHD care and should be an integral part of multidisciplinary intervention strategies.

Keywords: ADHD, parenting stress, depression, anxiety, suicidal risk, well-being, quality of life, children,

1 Introduction

Raising a child with ADHD poses numerous challenges, particularly for parents and caregivers, and may affect overall family functioning, parent-child interaction, and parental mental health. Most studies mapping the family environment of children with ADHD focus on the level of parenting stress and overall psychological well-being among parents of children with ADHD, as well as associated risk and protective factors, including contextual factors (e.g., the pandemic, socioeconomic status, and the broader environment). Further research addresses ways to modify these factors through specific interventions aimed at improving parental well-being.

This article provides an overview of current knowledge in the field, focusing primarily on the mental health of parents of children with ADHD and potential interventions in this area. Parent-related factors: stress, mental health, well-being, and quality of life among parents of children with ADHD.

1.1 Parenting stress as a key factor

Parenting stress is conceptualized as a subjectively experienced psychological burden arising from the demands of the parenting role and childrearing, particularly when the parent perceives an imbalance between the demands placed on them and the resources, competencies, or support available to them (Abidin, 1992; Abidin, 1995). Among parents of children with ADHD, parenting stress is often amplified by the chronic nature of the child's difficulties, recurrent conflicts, increased demands on behavioral regulation, and frequent failure of typical parenting strategies (Abidin, 1995).

A quantitative study by Craig et al. (2016), conducted on a large sample of parents of children with neurodevelopmental disorders, aimed to compare levels of parenting stress across different clinical groups. The analysis showed that parents of children with ADHD exhibited among the highest levels of parenting stress, and mothers reported a greater burden than fathers (Craig et al., 2016). The authors explained this difference by noting that mothers often assume the primary role in managing the child's challenging behavior on a daily basis. Similarly, a national quantitative analysis by Ko and Jeong (2024), based on nearly a decade of Korean population survey data, found that mothers of children with ADHD reported higher levels of stress, depression, and psychological distress than

mothers of children without ADHD. Among fathers, the difference was less pronounced, supporting a gender-differentiated distribution of caregiving burden.

Studies conducted on large samples (Craig et al., 2016; Ko & Jeong, 2024) indicate that parents of children with ADHD not only show higher levels of stress and psychological difficulties compared with parents of typically developing children, but also higher levels of stress compared with parents in other clinical groups (Craig et al., 2016). Both studies also highlight a higher burden among mothers, suggesting a gender-differentiated distribution of caregiving demands, with mothers carrying a larger share of the daily management of the child's challenging behavior.

A study by Winfield et al. (2023), conducted among parents of children with ADHD during the COVID-19 pandemic, showed that parenting stress increases further during crisis periods. The authors demonstrated that pandemic-related measures disrupted family routines and led to an overall rise in stress and emotional exhaustion among parents. In the qualitative part of the study, parents described how the combination of home-schooling, reduced services, and worsening child behavior contributed to feelings of overload and burnout.

A mixed-methods study by Wu et al. (2025), focusing on the challenges faced by parents of adolescents with ADHD during the pandemic, found that the most significant predictor of parenting stress was not the pandemic itself but the baseline level of stress prior to the pandemic, suggesting the cumulative nature of parenting burden associated with caring for a child with ADHD.

1.2 Parental mental health (depression, anxiety, suicidal risk)

Elevated parental stress burden is associated with a higher prevalence of compromised parental mental health. Studies conducted in different cultural contexts consistently report increased rates of psychological difficulties such as depression and suicidal ideation (Al-Balushi et al., 2019; Ko & Jeong, 2024). Al-Balushi et al. (2019) report clinically significant depressive symptoms in up to 65% of caregivers and identify low socioeconomic status, the absence of another caregiver, and more severe child symptomatology as key predictors. Ko and Jeong (2024), in addition to the above outcomes, also emphasize higher levels of anxiety.

A quantitative study by Al-Balushi et al. (2019), conducted on 100 caregivers of children with ADHD in Oman, aimed to identify the prevalence of depressive symptoms and their predictors. The authors found that up to 65% of caregivers reported clinically significant depressive symptoms, with key predictors including low socioeconomic status, the absence of an additional caregiver in the household, and severe child symptomatology. The study thus shows that parental mental health is substantially shaped by psychosocial factors.

The analysis by Ko and Jeong (2024), using representative Korean population data, demonstrated that mothers of children with ADHD have a significantly higher risk of depression and suicidal ideation. This large-scale quantitative study also identified higher anxiety, further confirming the high psychological burden associated with long-term care for a child with challenging behavior.

Another important contribution is provided by Romaniuk et al. (2022). This quantitative study, focusing on the quality of life of families of children with ADHD and autism, was conducted among mothers and showed that even when overall family functioning is relatively stable, mothers' emotional well-being is significantly reduced. The authors emphasize that emotional

exhaustion may be present even when other aspects of family life appear to function well.

1.3 Well-being and quality of life of mothers and families

A significant perspective on the quality of life of mothers of children with ADHD is offered by Piscitello et al. (2022), conducted with mothers of adolescents. The study examined how ADHD affects maternal quality of life and found that mothers of adolescents with ADHD reported significantly lower quality of life than mothers of adolescents without ADHD. Among the strongest predictors of reduced quality of life were maternal depressive symptoms and the severity of the child's behavioral problems.

A complementary perspective on family quality of life is provided by Romaniuk et al. (2022), who compared families of children with autism and ADHD. Conducted among mothers, the study showed that while overall family quality of life may not differ dramatically, mothers' emotional well-being was systematically lower in families of children with ADHD. The authors interpret this as a consequence of chronic burden associated with high demands on supervision, structuring daily routines, and managing behavioral problems.

Zhang et al. (2022), examining a family-based physical activity program, found that increasing family physical activity improved not only the child's behavior but also parents' emotional well-being. This quantitative study underlines that parental quality of life can be enhanced through changes in everyday family functioning.

1.4 Modifiable factors and intervention effects

Parent-focused interventions appear to be a major modifiable component influencing parenting stress and parental well-being. A randomized controlled trial by Lo et al. (2020), conducted among families with children with ADHD, demonstrated that a family-based mindfulness intervention reduced parenting stress and improved parental well-being, while also improving the child's symptomatology.

A quantitative study by Neece (2014), examining mindfulness-based stress reduction (MBSR) in parents of young children with developmental delays, reported significant reductions in parenting stress and depressive symptoms after program completion, along with positive secondary effects on child behavior.

An important finding is also offered by the telehealth study by Fossum et al. (2016). The study conducted among parents of children with behavioral disorders showed that parental psychological distress (e.g., depression or anxiety) did not moderate the effectiveness of online parent training. These findings are significant because they suggest that even highly burdened parents can benefit from interventions if they are flexible and accessible.

1.5 Interventions for parents of children with ADHD and other neurodevelopmental disorders

Interventions targeting parents constitute a key area of support for families of children with ADHD and other neurodevelopmental disorders. Research indicates that parenting competencies, parental mental health, and family functioning substantially influence treatment effectiveness and the degree of improvement in the child's symptoms. Therefore, a wide range of interventions has emerged—from art therapy, through family and narrative approaches, to structured programs supporting mothers and families.

Positive evidence is reported by studies evaluating these interventions. Lo et al. (2020) and Neece (2014) show that mindfulness-based interventions—either family-based or designed directly for parents—significantly reduce parenting stress and depressive symptoms and increase subjective well-

being. At the same time, improvements are observed in children's behavior, particularly in attention and ADHD symptoms. This supports the parent's role as a key actor in the therapeutic process: interventions focused on parental coping strategies have not only a direct effect on parental mental health but also an indirect effect on the child's symptoms.

However, intervention effectiveness does not appear to depend solely on parents' baseline mental health. Fossum et al. (2016) showed that higher levels of parental depressive, anxiety, or stress symptoms did not reduce the effectiveness of telehealth-based parent training. This is important because it suggests that even parents experiencing high psychological burden can benefit from programs if the intervention is structured, accessible, and well delivered.

1.6 Art therapy and its impact on parenting burden and well-being

Art therapy represents a specific intervention primarily targeting parents' emotional experiences and the reduction of stress associated with caring for a child with a neurodevelopmental disorder. Ouane et al. (2022) showed that group art therapy significantly improved mothers' psychological well-being, particularly in emotional regulation, stress management, and the quality of parenting experience. After a 12-week program, mothers reported lower psychological burden and better capacity to cope with challenging child behaviors, which the authors interpret as changes in self-reflection and parental coping strategies (Ouane et al., 2022).

A further key benefit of art therapy is a reduction in subjective feelings of isolation and the strengthening of shared experience among mothers of children with neurodevelopmental conditions. An interdisciplinary approach may also support linking art-therapeutic techniques with psychoeducation, contributing to more sustained improvements in mothers' quality of life.

1.7 Family-based interventions: approaches targeting the whole family

Family-oriented interventions assume that ADHD significantly affects the family system and that change solely at the level of the child is often insufficient. Lo et al. (2020) examined the effectiveness of a family-based mindfulness intervention targeting both parents and children with ADHD. The authors found that this intervention not only reduced the child's ADHD symptoms but also substantially decreased parenting stress and improved parental well-being (Lo et al., 2020). Parents also reported improved quality of family interactions and fewer conflicts.

Further research confirms that family-focused interventions improve communication patterns, strengthen parenting competencies, and reduce the negative emotional climate in the family. Goertz-Dorten et al. (2019) found that the THAV intervention, which includes components of social skills training, parent work, and behavior modification, improved children's prosocial behavior and significantly reduced parenting stress (Goertz-Dorten et al., 2019). The authors attribute this effect to increased parental self-efficacy and better understanding of child behavior.

Family interventions also demonstrate effectiveness across different age groups and types of neurodevelopmental conditions. Zhang et al. (2022) reported that increasing physical activity through a family-based program improved quality of life for both children with ADHD and their parents, with parents reporting better emotional functioning and lower stress (Zhang et al., 2022).

1.8 Narrative therapy and work with family identity

Narrative approaches emphasize how parents and children "tell the story" of their lives and of the impact of ADHD on the family. M. Lee et al. (2022) reported that multiple family

narrative therapy helps families transform negative and deficit-focused narratives about the child with ADHD into competence-oriented narratives that promote hope, a sense of control, and improved family functioning.

Parents reported that narrative techniques helped them better understand their own reactions, reduce self-blame, and shift from a pathologizing view of the child to a perspective emphasizing strengths, achievements, and family resilience resources (Lee et al., 2022). The authors also observed improvements in the emotional climate of the family and better communication between parents and children.

The contribution of narrative therapy appears particularly important in families experiencing long-term high stress and negative interaction patterns. Research suggests that changing the language and narrative about the child's behavior may lead to more enduring shifts in parenting attitudes than standard behavioral interventions.

1.9 Group programs for mothers of children with neurodevelopmental conditions

Group programs targeting mothers of children with ADHD or other neurodevelopmental difficulties appear highly effective in reducing parenting stress and improving psychological well-being. Romaniuk et al. (2022) reported that mothers of children with ADHD show markedly lower emotional well-being and high psychological burden, highlighting the need for targeted support programs. Such interventions are effective partly because they provide a shared space to identify problems, learn coping strategies, and receive support from parents with similar experiences.

Both art-therapy groups (Ouanes et al., 2022) and psychoeducational parent training (e.g., telehealth interventions in Fossum et al., 2016) led to improvements in depressive symptoms, reductions in stress, and higher perceived parenting competence. Group interventions also offer meaningful social anchoring, reducing feelings of isolation and exhaustion.

Additional studies confirm that mothers benefit from programs combining shared experience, emotional support, and practical strategies. For example, Lee et al. (2022) suggest that involving multiple families increases normalization of the experience and strengthens the ability to frame parenting difficulties as a shared phenomenon rather than individual failure.

1.10 Telehealth and online forms of parent intervention

A notable group of interventions includes programs delivered online. Fossum et al. (2016) found that parental psychological difficulties (e.g., anxiety, depression, or high stress) did not moderate the effectiveness of telehealth-delivered behavioral parent training. This finding is significant because it suggests that remote interventions can be effective even for highly burdened parents, who often represent a group with high need for support but limited ability to attend in-person services (Fossum et al., 2016).

Parents reported improvements in understanding children's behavior, reduced emotional reactivity, and greater self-confidence in setting boundaries. This research thus supports wider use of digital intervention formats for families of children with ADHD.

Parent-focused interventions are an important component of family support, and their effectiveness is well supported by research evidence. Art therapy improves emotional well-being and reduces stress; family-based interventions strengthen interactions and reduce the negative emotional climate; narrative therapy changes how families make sense of ADHD and their own functioning; and group programs reduce isolation and enhance social support. Telehealth findings indicate that even parents experiencing high psychological burden may benefit substantially from intervention programs. Together, these

approaches confirm that work with parents is an essential component of effective support for children with ADHD.

1.11 Contextual factors influencing parents of children with ADHD (pandemic, socioeconomic status, broader environment)

Contextual factors such as societal crises, family socioeconomic conditions, and the structural availability of support services significantly influence the psychological well-being of parents of children with neurodevelopmental disorders. The reviewed research suggests that these factors may increase parenting stress, worsen parental mental health, and affect parents' capacity to respond effectively to the needs of a child with ADHD.

1.12 The COVID-19 pandemic as a major stress-amplifying factor

The COVID-19 pandemic represented a unique stressor that substantially affected families of children with ADHD. A mixed qualitative-quantitative study by Winfield et al. (2023), conducted among parents of formally diagnosed children with ADHD, aimed to identify the pandemic's impact on family mental health. The authors found increased anxiety, poorer emotion regulation, disrupted routines, and increased problematic behavior among children with ADHD during the pandemic, with substantial deterioration also reported by parents. The study documented increases in depressive and anxiety symptoms, higher perceived stress, and overload associated with home-schooling, in which parents often acted as the primary facilitators of education (Winfield et al., 2023).

A further analysis by Wu et al. (2025), focusing on parents of adolescents with ADHD, showed that the most important predictor of parenting stress during the pandemic was not the pandemic circumstances per se, but the level of stress prior to the pandemic. This suggests that the long-term burden of caring for a child with ADHD makes parents more vulnerable to external crises. The study also demonstrated that parents entering the pandemic with limited social support or depleted coping resources experienced the greatest deterioration in mental health (Wu et al., 2025).

Both studies confirm that the pandemic acted as an "amplifier" of pre-existing burden, with key mechanisms including disrupted routines, isolation, increased demands related to supporting children during home learning and generalized uncertainty.

1.13 Socioeconomic factors and their role in parental mental health

Family socioeconomic conditions appear to be among the most important factors affecting the mental health of parents of children with ADHD. A quantitative study by Al-Balushi et al. (2019) in Oman found clinically significant depressive symptoms in up to 65% of caregivers. Key predictors included low household income and the absence of an additional caregiver in the household. The study also showed that higher psychological burden was associated with the hyperactive-impulsive and combined presentations of ADHD in the child (Al-Balushi et al., 2019). These findings support the hypothesis that socioeconomic deprivation amplifies the already demanding parenting role.

Ko and Jeong (2024), analyzing a large national dataset in Korea, similarly documented that mothers of children with ADHD more frequently report depression, anxiety, and suicidal ideation. While income status was not identified as an independent predictor, the authors emphasize that socioeconomically disadvantaged families showed higher burden particularly in access to care, school collaboration, and material security (Ko & Jeong, 2024). Socioeconomic status thus operates not only as a static factor, but also as a determinant of access to interventions, the capacity to cope with crises, and overall levels of parenting stress.

1.14 The broader family and community environment

The broader family dynamics and the availability of social ties significantly affect the psychological burden among parents of children with ADHD. Romaniuk et al. (2022) found that although overall family quality of life may be average, mothers' emotional well-being is substantially reduced, which the authors interpret as an outcome of long-term cumulative burden. The results also suggest that insufficient social support is one of the strongest predictors of low emotional well-being (Romaniuk et al., 2022).

Qualitative findings from Winfield et al. (2023) further indicate that parents often describe a lack of supportive infrastructure, limited access to mental health services, and low levels of school support during the pandemic. Such structural barriers contributed to increased feelings of isolation, helplessness, and chronic stress.

Zhang et al. (2022) also showed that positive changes in families are more likely where family functioning is strong, routines are present, and shared activities are maintained. The authors argue that these elements may act as important protective factors mitigating the impact of ADHD on parental psychological burden (Zhang et al., 2022).

2 Conclusion

Available studies clearly indicate that parents of children with ADHD constitute a high-risk group in terms of parenting stress, mental health, and quality of life, and that this burden is long-term and cumulative. Findings repeatedly show higher levels of stress, depression, and anxiety among mothers, with important contributions from both child-related factors (symptom severity, comorbidity) and contextual factors (socioeconomic conditions and the availability of social support). At the same time, evidence suggests that targeted parent-focused interventions—mindfulness programs, art therapy, family-oriented and narrative approaches, group programs, and telehealth modalities—can significantly reduce parental psychological burden and improve family functioning, thereby indirectly contributing to reductions in child symptom severity. Contextual factors such as the COVID-19 pandemic and socioeconomic deprivation do not operate in isolation but further amplify the existing burden in families of children with ADHD. These findings imply that care for a child with ADHD should systematically include support for parents and work with the family environment, both at the level of individual interventions and through broader systemic measures in education and health-social services.

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Primary Paper Section: A

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THE ROLE OF TOUR OPERATORS IN URBAN AND RURAL TOURISM DEVELOPMENT OF SARAJEVO CANTON

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The paper is the product of a non-budget scientific research project (*"The Role of Tour Operators in Urban and Rural Tourism Development of Sarajevo Canton,"* March-December, 2025) that was implemented in cooperation with five inbound tour operators located in Sarajevo (project leader: Prof. Dr. Lejla Žunić, Assoc. Prof. at the University of Sarajevo). This paper has never been published before.

Abstract: The paper investigates the functional role of inbound tour operators in the urban and rural tourism development of Sarajevo Canton by analyzing relevant parameters such as their business dynamics and collaboration with stakeholders, products, the typology of tourists and stays, and the promotion and sustainability of the offerings. A survey and interviews were conducted with five inbound tour operators situated in the most prominent zone (Old Town with Baščarsija). The findings indicated a strong impact of the inbound tour operators on tourism spatial development, as they are pivotal in fostering stakeholders' collaboration and in marketing and selling local authentic products to international tourists. Their endeavors contribute to creating unforgettable tourist experiences in Sarajevo, particularly concerning city and dark tours, ecotourism, and crafts. Tourist products are disseminated through WOM, international fairs, and online platforms, targeting markets in the EU, the USA, and Canada. This approach enhances international cooperation and promotes the destination's tourism. Inbound tour operators exhibit a positive business trend, although there are notable disparities in the level of collaboration with stakeholders and the focus of policies. Certain areas of action have been overlooked, such as strategies to position Sarajevo as a primary choice and final destination, identifying new potential markets, and adopting a more analytical approach to tourist typologies for more tailored tourism offerings. The paper highlights the current features and challenges of the destination's tourism development, providing practical solutions for inbound tour operators and recommendations for redesign.

Keywords: Sarajevo destination, inbound tourism, tour operators, stakeholders, tourism products, tourists, stay, target markets, promotion, tourism business.

1 Introduction

1.1 Theoretical background

Inbound tour operators and travel agencies play a vital role in the tourism development of a destination, as they focus on inbound tourism and „organize and sell travel packages within their own country for foreign tourists" (UNSD, 2025). The literature (Hossain et al., 2025; UNSD, 2025; Cambridge Dictionary, 2025; Zou, 2023; Science Direct, 2025; Žunić, 2022b; Žunić, 2023; Wormser & Steffen, 2010) stated that tour operators and agencies are intermediaries between tourism supply and demand, with the difference that tour operators create and market their own tourism products with elements of travel, accommodation and stay included, which are then sold by travel agencies, which are less often involved in the creation of their own products. Travel agencies are the fundamental "entities within the travel industry that assist customers with travel arrangements" (Wormser & Steffen, 2010), taking into account personal preferences and budget when booking, etc.

According to the Law on Tourism in the Sarajevo Canton (2025), a travel agency is a legal entity registered in the register of companies that organizes tourist and business trips and stays, mediates and provides all other services related to this, and sells its own tourism product, which it creates by combining various types of tourist services. The standard categorization includes 2 types: a) a travel agency - a travel organizer (tour operator), and b) a travel agency - an intermediary, with a set of defined services and activities. Agencies are also differentiated depending on their orientation to inbound or outbound tourism, or a combined type.

Since Bosnia and Herzegovina has been experiencing a tourism expansion over the last two decades, for example, "in 2019, the country had the third-highest tourism growth rate in the World" (Žunić et al., 2023), together with Sarajevo Canton - the leading tourism destination in the country (Žunić, 2024), thus, a "positive trend of growth of travel agencies in the country was observed, especially in the capital, primarily within the most important tourist zones: the Center with the Old Town and Iličić near the Sarajevo International Airport" (Žunić: 2022b, 2023). Today, a large number of travel agencies operate in the Sarajevo Canton, although the fewest are those focused on inbound tourism. Since "the Old Town with Baščarsija - the most popular site in Sarajevo, has the highest tourism representation" (Žunić, 2018), agencies from that location were included in the research. Only agencies focused on inbound tourism (3) or with combined business - selling foreign and domestic packages (1), and a local tour operator (1) were sampled. The paper uses the term "inbound tour operator" for all five business entities, because these are agencies that are engaged in attracting foreign tourists and selling domestic or related tourist packages to foreign tourists in our country, i.e. in the Sarajevo Canton (inbound tourism).

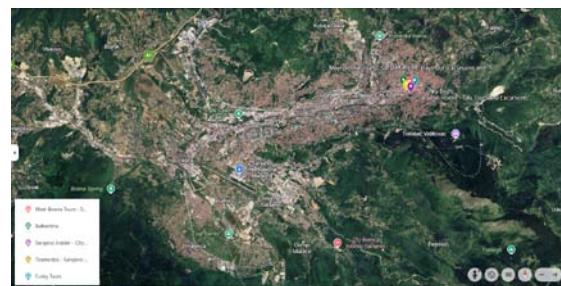


Fig.1. Location of inbound tour operators - Old Town Sarajevo - urban tourist zone
 (Corresponding author)

"Inbound tourism comprises the activities of a non-resident visitor within the country of reference on an inbound tourism trip" (UN Tourism, 2025a), which is an important contributor to the spatial development of a destination. Numerous authors (Corne et al., 2024; Kochar, 2022; Arain et al., 2020; Enríquez-Perales et al., 2022; Madaleno et al., 2019; Tsaur & Chen, 2018; Cetin & Yarcan, 2017; Žunić: 2022b, 2023) emphasize the importance of inbound tourism for the sustainable social and economic development of a destination, because an increased number of foreign tourists in a country most stimulates the generation of tourism revenues, strengthens the local economy and improves living standards, increases diverse productivity and cooperation between stakeholders and tour operators, contributes to the development of cultural and international cooperation, and opens avenues for foreign direct investment, etc. Accordingly, the focus of the paper is on inbound tour operators, which operate in the most attractive part of the Sarajevo Canton, contributing to the specific beneficial features of its tourism development.



Fig.2. Baščaršija, Old Town Sarajevo: an oriental-Ottoman cultural landscape in the capital of Bosnia and Herzegovina as the most prominent tourist site
(Corresponding author)

1.2 Tourism-geographic ID of the Sarajevo Canton destination

Sarajevo (43°N, 18°E, 34T) represents the largest urban and tourist center of gravity in Bosnia and Herzegovina, which is impressed by the globally recognized features of the tourist image of this growing European destination:

- artistic and creative city, "Sarajevo UNESCO City of Film" (UNESCO, 2025), after the popular international event Sarajevo Film Festival visited by famous celebrities such as Meg Ryan (SFF-2024), among others;
- a centuries-old tradition of a European multicultural tourist destination, the "European Jerusalem" (in Census 2013, Bosniaks 83.8%, Croats 4.2%, Serbs 3.2%, others 8.8%);
- "the city with the longest siege in modern European history" (Žunić, 2023);
- the bridge of urban and natural tourism, as the city's mountain-valley topography and good connection with surroundings allow for rural and ecotourism to be included in the offerings of the canton (Žunić et al., 2024; Žunić, 2022);
- the urban destination with unique charm composed of the urban, provincial, and nature vibrations, providing a vacation that harmoniously integrates aspects of both urban and natural settings.

Altered exponential growth in tourism has been observed in the Sarajevo destination (Fig.3) over the past twenty years (2004-2024) as a result of COVID-19, following which the tourism sector has continued to document even more advantageous quantitative metrics regarding arrivals and overnight stays compared to the period prior to the global pandemic.

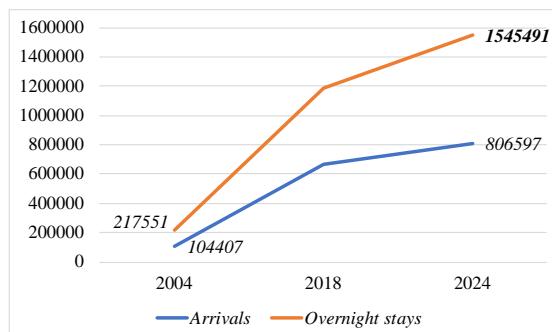


Fig.3. Increase in arrivals and overnight stays in the Sarajevo Canton destination 2004-2024.
(Own research)

The pattern of overnight stays by arrivals in Sarajevo Canton fluctuates over the course of the year (Fig.4), becoming more intricate during the summer months. Additionally, visitors from

Turkey consistently represent the largest group of overnight guests throughout the year, irrespective of seasonal variations.

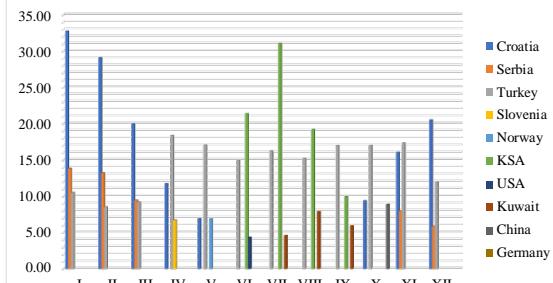


Fig.4. Leading arrivals in total overnight stays in Sarajevo Canton in 2024 - in percentages
(Own research)

The greatest diversity of overnight stays is during the warmer part of the year (April-October). Three countries are most represented in overnight stays in Canton Sarajevo during 2024: Turkey, the Kingdom of Saudi Arabia, and Croatia:

- Turkey holds the 1st place for 5 months of the year: spring and fall (IV-V and IX-XI);
- KSA holds the 1st place during the summer season (VI-VIII);
- Croatia holds the 1st place for 4 winter months (I-III and XII).

The leading overnight stays categorized by arrivals can be divided into various geographical and temporal segments, with the Turkey as consistent factor among all of them, who frequently rank among the top three nations regarding total overnight stays in Sarajevo Canton:

- I-III and XI-XII 2024: Croatia, Serbia, and Turkey;
- IV 2024: Turkey, Croatia, and Slovenia;
- V 2024: Turkey, Croatia, and Norway;
- VI 2024: KSA, Turkey, and USA;
- VII-IX 2024: KSA, Turkey, and Kuwait;
- X 2024: Turkey, Croatia, and China.

2 Research methodology

Fundamental-applied research investigates the contribution of tour operators to the development of urban and rural tourism in the Sarajevo Canton, aiming to identify and assess the current trends and challenges faced by this prominent destination in Bosnia and Herzegovina. A survey and interviews were conducted with representatives from five inbound tour operators situated in the most frequented tourist area (Old Town with Baščaršija), and a thematic map was created using the Google My Maps tool (an original project). Various parameters pertinent to understanding the spatial development of tourism in the destination were analyzed: statistics on arrivals and overnight stays, the collaboration of tour operators with stakeholders, the tourist offerings and products, the typology of tourists and their duration of stay, as well as the business, promotion, and competitiveness of the offerings. The results were processed using statistical methods accompanied by graphical representations (Excel). Potential limitations of the research include the reduced representativeness of the sample for the broader population, the subjectivity of the respondents, and the limited availability of statistical data. Consequently, the results were validated through triangulation methods, comparing findings obtained from fieldwork (explicit reports with observational insights in the destination) and document analysis. This paper highlights the strengths and weaknesses of Sarajevo's tourism influenced by inbound tour operators, providing practical recommendations for enhancing their role in fostering more sustainable tourism development in the destination.

3 Results and discussions

3.1 Collaboration of inbound tour operators and stakeholders

Inbound tour operators in Sarajevo work in partnership with a range of stakeholders from the public, private, and non-governmental sectors. They maintain the most robust collaboration with hotels, transportation companies, and other tour operators, as these entities offer essential services such as visitor accommodation, transportation, cultural experiences, and travel organization.

Tour operators maintain the most robust collaboration with essential tourism stakeholders (Fig.5): hotels, transport companies, and tour operators (100%), whereas their cooperation is least prevalent with airlines (20%) and foreign investors (40%).

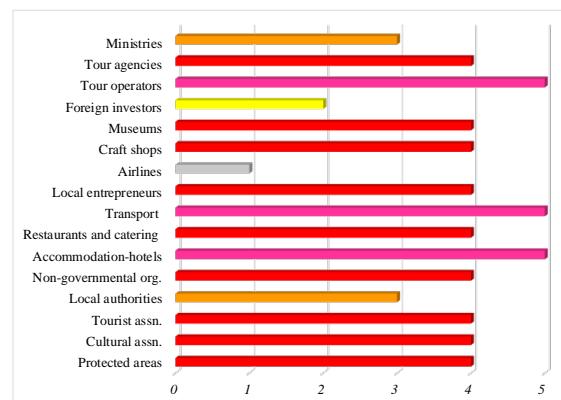


Fig.5. Collaboration between inbound tour operators in Sarajevo and various stakeholders
(Own research)

Hotels and accommodation facilities are of priority importance for inbound tour operators to satisfy the primary need of tourists for overnight stays. "The accommodation rating is high, hotels are the most represented category, and the highest concentration of accommodation units and luxury hotels is in the municipality of Stari Grad Sarajevo" (Žunić, 2018, 2022), which contributes to partnership relations between tour operators and hoteliers, while visitor reviews can improve business and image.

Cooperation between inbound tour operators and transport companies is important for the development and success of the tourism industry, due to the connection of tourism supply with demand and the organization of travel.

Inbound agencies and tour operators collaborate through team work, research, creation and sale of tourist products, which is the primary form of partnership for all five Sarajevo inbound tour operators, especially if they are declared as agencies, and therefore, in a hierarchical and operational sense, they are significantly dependent on the responsible tour operator.

Furthermore, collaboration between inbound tour operators and relevant categories for planning a more enriching stay at the destination (80%) is crucial, as it facilitates the development of creative tourism products associated with culture and nature, or integrated visits. For instance, the partnership between inbound tour operators and museums provides visitors with a cultural and educational experience, alongside generating revenue from visits, making museums indispensable sites when arranging trips and tours in Sarajevo. "Sarajevo museums are the most popular in Bosnia and Herzegovina, especially dark, national, and ethno-musicological-gastronomic, and play a key role in enhancing the cultural image of the tourist destination" (Žunić, 2024). Tour operators also have strong cooperation with protected area agencies, which indicates that they have well recognized the demands of modern visitors, because "green sites of Sarajevo are

generally popular among domestic and foreign tourists" (Žunić, 2018, 2023), and visits to eco-areas contribute to the preservation of biodiversity along with economic benefits.

The collaboration between inbound tour operators and relevant institutions (60%) is crucial, as tour operators conduct their business activities with governmental support, which is essential for implementing tourism policy in the canton. This collaboration facilitates the exchange of ideas and the development of joint projects aimed at enhancing tourism and upgrading the tourist offerings or infrastructure. Tour operators play a vital role in executing tourism activities within the destination, while state and cantonal ministries (such as the Ministry of Foreign Trade and Economic Relations in Bosnia and Herzegovina, the Federal Ministry of Environment and Tourism, and the Ministry of Economy of the Sarajevo Canton) along with local government units (including nine municipalities in the canton, such as Stari Grad) serve as the „brains“ or strategic planners for tourism development, maintaining its sustainable spatial growth.

Tour operators exhibit the least collaboration with airlines and foreign investors, as they typically concentrate on executing established programs or functioning within regional tourism initiatives, rather than launching their own development projects in tourism. Given that inbound agencies are generally small or medium-sized, they lack the necessary capacity to engage in intricate international projects, which demand specialized personnel, technological resources, and a well-known reputation from foreign investors and airlines.

The most advanced stakeholder collaboration (refer to Fig.6) is represented by Sarajevo Insider (100%), which includes partnerships with airlines; this is the sole inbound tour operator that has emphasized this form of business collaboration.

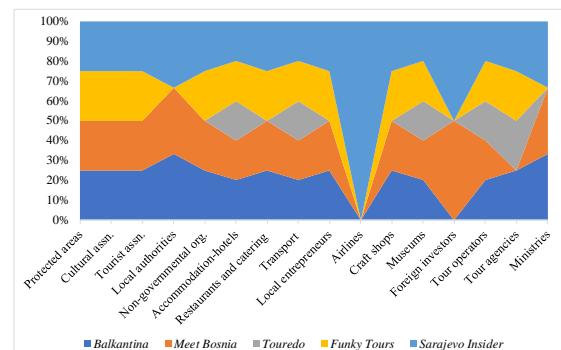


Fig.6. Mosaic of collaboration among individual tour operators and diverse stakeholders
(Own research)

Conversely, the least developed cooperation is observed with Touredo (31.3%), which concentrates on primary tourism entities and lacks collaboration with the majority of other stakeholders, such as authorities, protected areas, or local entrepreneurs. Additionally, a broader spectrum of cooperation is present with Balkantina and Meet Bosnia (88%), although they do not engage with airlines, foreign investors, or agencies.

3.2 Tourism offer and product diversity - thematic forms, tours and packages

In the literature (UN Tourism, 2025a,b; WTO, 2024; Schuh, Agapito, & Pinto, 2018; Žunić, 2018, 2022, 2023), the tourism offer, or tourism supply (*in a wider context of the term*), encompasses the material and spiritual heritage with the tourism infrastructure of the destination. It consists of various tourism products that are related to tourism activities in the destination, such as natural and cultural attractions and complementary services that are key to shaping the tourism experience. The tourism offer is influenced by numerous factors, including service providers- tour operators and travel agencies. Modern

destinations featuring a greater number of tour operators provide a superior and more competitive tourism offer.

Tourism products and the reasons for visiting are interrelated. The motivations behind tourist travel are varied; for instance, in the context of global inbound tourism, the primary motives include "recreation, leisure, and holidays (56%), followed by visiting friends and relatives, health, religion, etc. (29%), and work and training (11%)" (WTO, 2024). In contrast, in Sarajevo, the main attractions are its natural and cultural offerings, as well as its gastronomy (Žunić, 2018).

The destination of Sarajevo (Fig.7) showcases a variety of tourism forms, with urban, gastronomic, and cultural tourism being the most prominent, while rural tourism remains less developed. Additionally, transit tourism accounts for 40%, which is linked to the appealing location of inbound tour operators in Baščarsija (Fig.2), where visitors enjoy the famous Sarajevo ćevapi (a protected gastronomic brand) in the authentic Bosnian-oriental environment of Sarajevo. The following types of tourism are not represented: health, romantic, congress, event, spa, sports, entertainment, business, and VFR tourism.

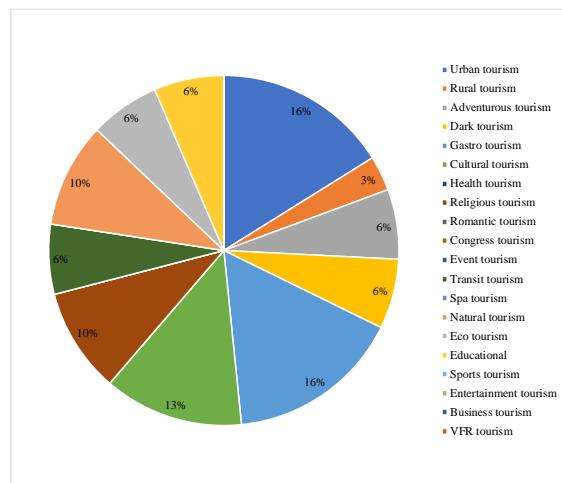


Fig.7. The composition of Sarajevo's tourism offerings – forms of tourism available in the destination
(Own research)

The dominant types of tourism (Fig.8) include urban and gastro tourism, followed by cultural tourism, as well as natural and religious tourism, which collectively represent 60% of Sarajevo's overall tourist offerings.

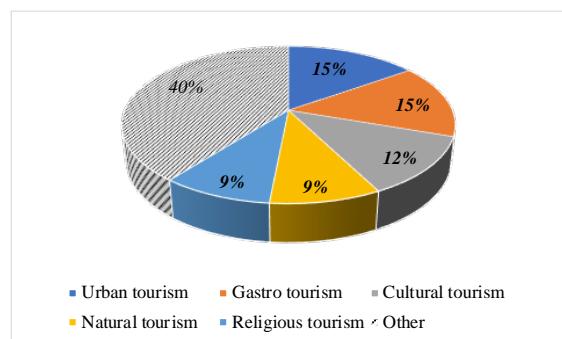


Fig.8. Prevailing forms of tourism among inbound tour operators
(Own research)

Among the top requested tourist products (Fig.9), the list comprises city and nature tours, with dark tours, crafts and workshops, and combined tours following closely behind. Nearly all tour operators have included city and nature tours in their offerings, with the exception of Touredo, specialized exclusively in city dark tourism.

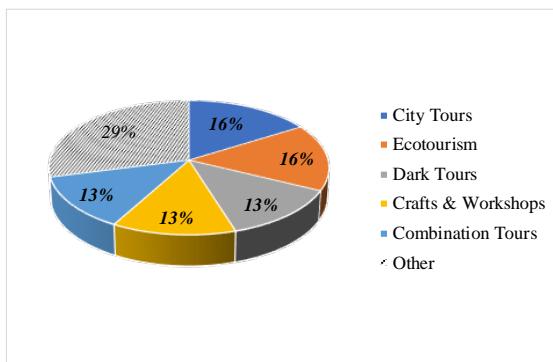


Fig.9. Top tourism products at inbound tour operators
(Own research)

Predominant tourism products in the destination (Fig.10) include city tours, dark tours, ecotours, and craft tours, which collectively account for 58% of the overall tourist offerings.

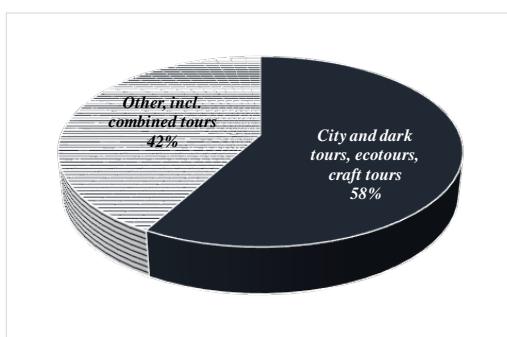


Fig.10. Predominant tourism products in Sarajevo tourism offer
(Own research)

Sarajevo is a "unique symbol of universal multiculturalism - a continuously open city" (UNESCO, 2025) and represents the multiethnic center of the Balkans and Europe with a sedimented polyvalent architecture composed of combined artistic styles of the East and the West, thus, it can meet various visitors' demands. The greatest tourism value holds the rich Ottoman and Austro-Hungarian heritage, along with the dynamic linear-radial spatial composition of the urban pluralistic center, which developed in a valley with seven hills. Urbanization is increasing as Sarajevo expands daily, evolving into an urban region that connects with its surrounding areas through infrastructural advancements. "Urban tourism is a type of tourist activity which takes place in an urban space where a broad and heterogeneous range of cultural, architectural, technological, social and natural experiences and products for leisure and business are offered" (UN Tourism, 2025a), thus, Sarajevo, with its popular city and nature tours stands for the representative urban tourism destination in the world. Furthermore, traditional gastronomy, featuring an authentic expression "tailored to suit everyone's taste" (Žunić & Nezirović, 2022), incorporates a blend of influences from the Orient, the Balkans, Central Europe, and the Mediterranean, making it an integral component of an unforgettable experience in Sarajevo. Consequently, gastro tours are often combined with city tours, among other offerings. Given the green surroundings and eco-sites (IUCN III-V) located not far from the city center, "Sarajevo serves as the bridge between natural and urban environments, enhancing its overall tourism image and demand" (Žunić, 2023), thus, excursions to natural areas are one of the top products in the canton.

City tours are structured excursions that provide tourists with the chance to discover and engage with local landmarks, culture, and nature. In addition to local tours, inbound tour operators arrange city tours across Bosnia and Herzegovina. More innovative local tourism offerings, which are included in city tours (such as those in Sarajevo), feature culinary workshops - cooking classes (with the number of registered participants increasing annually), a tour

of Baščaršija, the city market, and visits to traditional shops and restaurants - food and drink (for instance, Sarajevo Gourmet Food & City Tour or Eat, Pray, Love), a traditional Bosnian dinner hosted by a local family, and photography tours (such as A Concrete Utopia - Brutalist Architecture of Bosnia and Herzegovina for 7 days). Additionally, the Honeymoon visit principle can also be implemented outside the canton in other regions of Bosnia and Herzegovina through private arrangements.

Within Sarajevo, visits to natural areas are also offered, such as: Skakavac Waterfall - mountain bike tour, Safari - hills around Sarajevo, Trebević, Via Dinarica hiking trail, ski touring on Jahorina, Bjelašnica and Igman, tour of Bijambara and Vrelo Bosna, etc.

Religious tours are mainly related to Islamic and Jewish sites, and the more popular is the Ramadan tour (visiting Islamic sites, performing prayers there, and holding iftar with a complete experience for every tourist).

War tours (e.g. War Tour, Tour of the War Tunnel, Tour of the Siege of Sarajevo, Meet Gavrilo Princip, etc.) are also very popular due to the "wartime image of Sarajevo" (Žunić, 2018), and the most iconic sites with a particularly intriguing tourist experience are: Latinska čuprija-Principov Most (Sarajevo assassination of Austro-Hungarian Prince Ferdinand as the reason for the First World War), and Tunnel of Hope (authentic attraction created under difficult wartime conditions under the runway of the International Airport of Sarajevo).

3.3 Tourist typology and sojourn/stay in the destination

Sarajevo exhibits a diverse composition of tourists based on arrivals (Fig.11), with the highest proportion coming from Australia and countries within the European Union, while there is a lesser representation from Korea and Japan. The following regions are not represented among inbound tour operators: GCC, Turkey, Malaysia, Indonesia, and Africa.

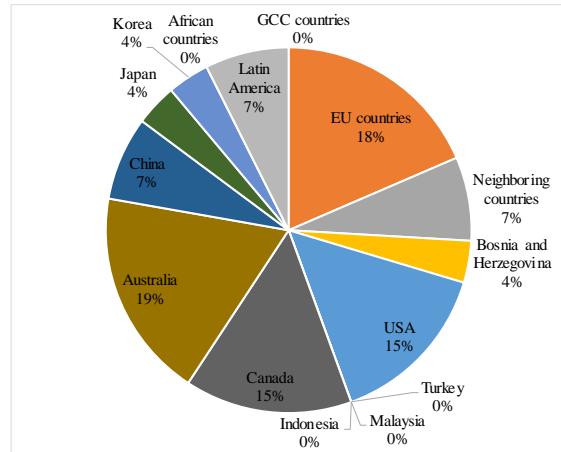


Fig.11. Tourists based on their arrivals at the Sarajevo destination – typical consumers of tourism products
(Own research)

For instance, the GCC countries, which represent a clientele of significant importance due to their extended stays and substantial spending in the destination, reportedly do not utilize the services of local tour operators. Several reasons contribute to this trend: the presence of a grey economy, which encompasses the use of private or informal channels for organizing travel and accommodation, as well as private or unregistered lodging providers or car rentals that offer considerably lower prices; the independence and flexibility exhibited by these visitors, who primarily arrange their own accommodations and explore the destination independently, often relying on recommendations from friends—previous visitors to Sarajevo—or through acquaintances in the destination; the absence of a certified halal

tourism product among inbound tour operators; the lack of private tours featuring Arabic-speaking guides; and the unavailability of organized exclusive and luxury services tailored to meet the needs of this category of tourists. The significance of these factors is exemplified by the fact that GCC tourists are the most frequent guests at Sarajevo's halal-certified Malak Regency (Ildža) hotel.

The majority of tourists arriving (as illustrated in Fig.12) in relation to the intermediary demand for tourist services in the receiving destination (Sarajevo) - including inbound tour operators, among others - originate from the EU, Australia, the USA, and Canada, accounting for 67% of the total clientele.

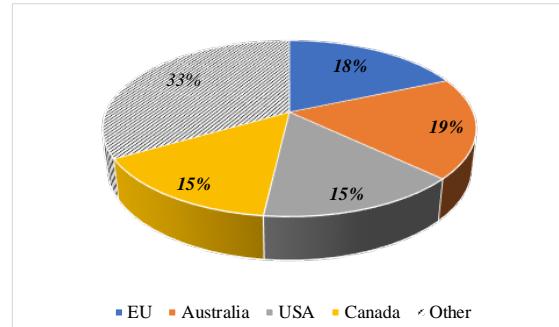


Fig.12. Predominant tourists by arrivals - consumers of Sarajevo inbound tour operator services
(Own research)

All inbound tour operators cater to service users from the EU and Australia (see Fig.13). Sarajevo Insider boasts the most diverse clientele regarding arrivals, including visitors from Korea and Japan (exclusively). This diversity is enhanced by effective promotion and collaboration with stakeholders, including global tourism partners and local service providers. Additionally, the appealing location, the language skills of guides (English, German, Arabic), and a positive reputation in the tourism market contribute to this success.

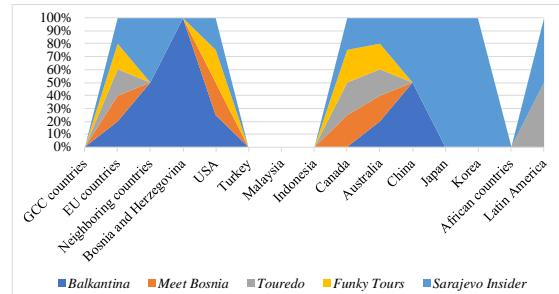


Fig.13. The composition of tourists based on arrivals at individual inbound tour operators
(Own research)

Inbound tour operators in Sarajevo cater to various social categories of tourists (Fig.14), with family tourists being the most prevalent, followed by students, while pensioners are less represented. Business and scientific tourists are the least represented. All tour operators serve both organized groups and individual tourists.

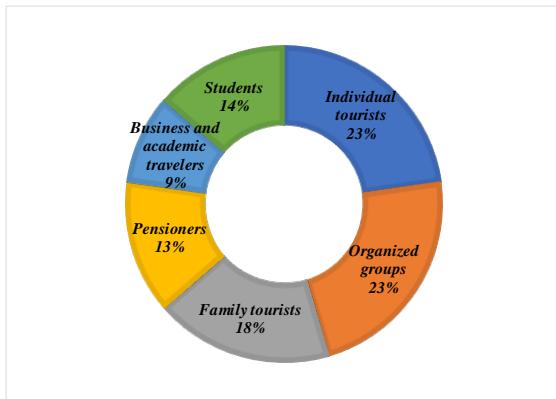


Fig.14. Categories of tourists according to arrivals - consumers of tourism products in Sarajevo
(Own research)

The most advanced form of differential cooperation exists between Meet Bosnia and Funky Tours (Fig.15), which includes the arrangement of personalized and private tours emphasizing local experiences – ranging from gastronomic tours to excursions to historical and cultural landmarks, in addition to appealing package offers for large groups of visitors such as corporate teams, educational institutions, or special interest groups. Similarly, tourism products designed for family tourists, students, and retirees are offered, featuring both entertainment and educational elements. In contrast, Balkantina, for instance, concentrates on individuals and groups rather than the social composition of service consumers.

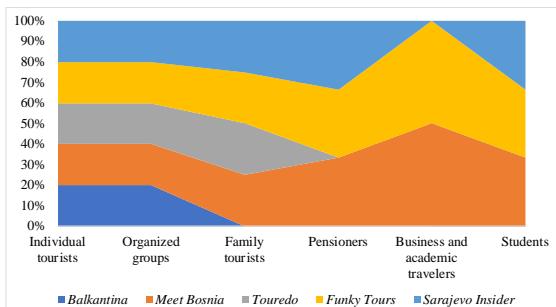


Fig.15. Mosaic of tourist categories - service consumers at individual inbound tour operators
(Own research)

Inbound tour operators report that the duration of stays in Sarajevo is generally brief, typically lasting up to 3 days or, in some cases, between 3 to 7 days (Fig.16). These visitors are frequently weekend or business tourists who tend to explore only sections of the Old Town or Baščarsija, whereas cultural tourists show a greater commitment to visiting museums, galleries, and similar attractions.

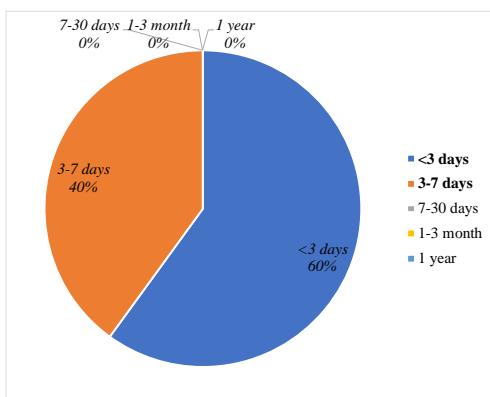


Fig.16. Duration of stay in Sarajevo destination
(Own research)

The brief or short duration of the stay reflects the static characteristics of the offerings provided by inbound tour operators, which likely depend on an outdated strategic document – the Tourist Product of the Sarajevo Canton (Chamber of Commerce, 2007). This document outlines the elements of an "optimal" three-day visit, with a focus on transit tourism. Furthermore, the limited collaboration between tour operators and governmental authorities leads to a deficiency in joint development initiatives within the tourism sector, which could facilitate enhancements in infrastructure and offerings (including a wider array of creative products that would captivate visitors with a more enriching and entertaining experience, thereby encouraging them to remain in the city).

Among the tour operators, in terms of stay, Meet Bosnia and Funky Tours are at the forefront (Fig.17). This is due to improved collaboration among stakeholders and a wider range of tourism services and products, which encompass the arrangement of both group and private tours across Bosnia and Herzegovina.

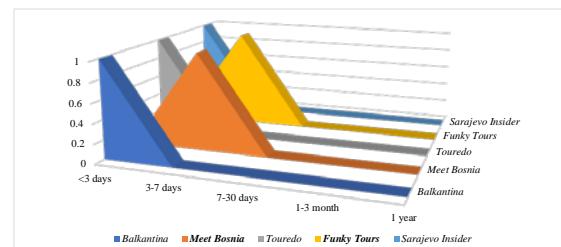


Fig.17. The composition of stay by length at specific inbound tour operators
(Own research)

In the composition of arrivals to the destination Sarajevo, based on the insights of inbound tour operators (see Fig.18), the majority of tourists originate from neighboring countries and the GCC, in addition to those from the USA and EU nations.

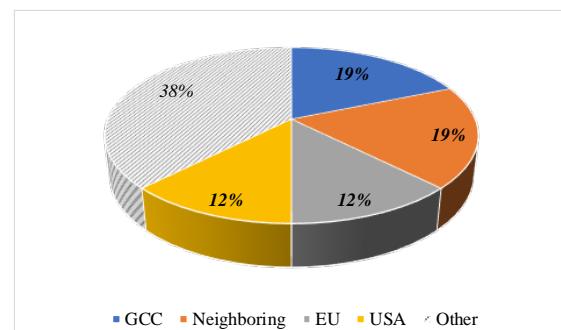


Fig.18. The composition of stay by arrivals to Sarajevo destination
(Own research)

Geographical proximity, cultural ties such as a shared or similar language, and business and trade relationships, including employment in the region or visiting family and friends, lead to an extended stay for tourists from neighboring nations/ countries (Croatia, Serbia, and Montenegro). They utilize agency services less frequently for activities like booking accommodations and city tours (therefore, they do not represent a target market for inbound tour operators), but they are more inclined to book trips to popular events or ski resorts. Tourists from the EU, such as Germany, Slovenia, Spain, Italy, Hungary, Switzerland, Sweden, the UK, etc., are drawn not only by cultural factors but also by significantly lower prices for accommodations, food, and activities compared to their home countries. Meanwhile, tourists from the GCC countries typically find Bosnia and Herzegovina appealing due to its lush landscapes and favorable climate, along with its distinctive European culture characterized by a strong Islamic heritage. Extended stays are also common among visitors from far-off countries like the USA, Canada, and

Australia, and inbound tour operators frequently collaborate with agencies and investors from these nations, making them their target markets. Additionally, the US Embassy in Sarajevo plays a crucial role in this context. These tourists show interest in exploring cultural and natural heritage or opting for various combined tours, among other activities.

The leading countries contributing to the composition of stays in Sarajevo (as illustrated in Fig.19) include the GCC, the USA, the EU, and neighboring nations, collectively representing 62% of the overall overnight stays.

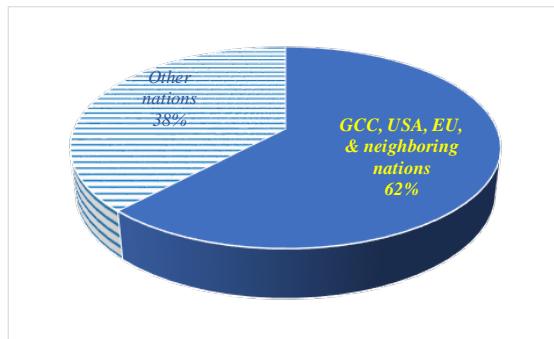


Fig.19. Top nations/ countries in a tourist stay in Sarajevo destination
(Own research)

The diverse characteristics of the stay composition among individual inbound tour operators (see Fig.20) are particularly highlighted in the case of Meet Bosnia, which exhibits the highest magnitude in the presented diagram due to its substantial number of clients from various countries, including the GCC, EU, USA, Turkey, Malaysia, China, and neighboring nations. In contrast, Touredo demonstrates the lowest magnitude, as it exclusively caters to tourists from the GCC, particularly in relation to the longest duration of stay at the destination.

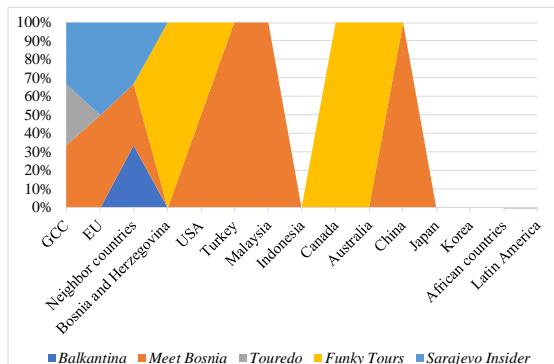


Fig.20. The composition of stays in Sarajevo at specific inbound tour operators
(Own research)

Notably, none of the five Sarajevo inbound tour operators have reported the presence of tourists from distant Asian countries such as Japan, Korea, or Indonesia, nor from regions in Latin America or Africa. For instance, there has been a noticeable decline in the number of arrivals and overnight stays from tourists originating from Indonesia, Japan, and Korea following the COVID-19 pandemic, as they tend to rarely utilize the services of local agencies, opting instead to plan their trips and accommodations independently. Additionally, an increasing number of young travelers are favoring individual trips organized through their native agencies. Furthermore, the visa requirements and higher costs compared to their home countries are seen as deterrents for visitors from Africa.

3.4 Business, promotion and sustainability of the tourism offer

In order to develop an effective business strategy, it is crucial to understand the dynamics of demand and supply in tourism, accounting for the complexity of tourism products, which are complex mixes of various services. Tourism demand is the requirement of various tourism products (goods and services, e.g. tour packages and guides, catering, or transport services) at a particular place or market in a given time period at a given price, and it depends upon various factors (geographical, socio-cultural, psychological, political, and international). "A tourism product is priced and sold through distribution channels" (UN Tourism, 2025b). Tour operators (wholesale) and travel agents (retail) are basic suppliers in tourism who sell tourism products, while other modes of supply include direct (online sale by parent organization), indirect (through affiliates), or personal (door to door) selling. IGNOU (2018) indicates that the greater presence of tour operators and travel agencies within specific markets provides better supply competitiveness.

All five inbound tour operators target the EU and the USA for the distribution and promotion of their products (Fig. 21 and 22), which constitutes 50% of their total promotional efforts, and when combined with Canada, this figure rises to 70%. Furthermore, they have a similar level of interest in Latin America, Japan, China, and Korea demand. However, their promotional efforts are less vigorous in the markets of Malaysia, Indonesia, and Australia, along with neighboring countries. The inbound tour operators exhibit no interest in promotion in the GCC and Mediterranean regions.

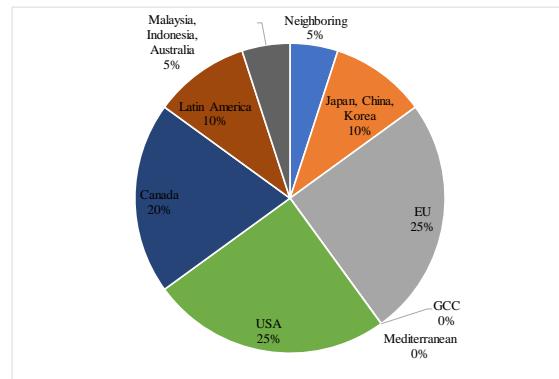


Fig.21. Target markets for the positioning of inbound tour operators' tourism offerings
(Own research)

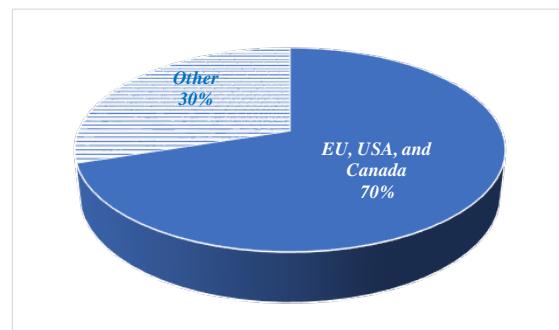


Fig.22. Top markets for promoting Sarajevo destination
(Own research)

The first-tier target markets (EU, USA, and Canada) represent the most developed geographical regions exhibiting considerable interest in Bosnia and Herzegovina, influenced by various geographical, political, and international factors. In the context of politics, culture, and economics, Bosnia and Herzegovina is actively pursuing integration with the European Union. The USA, for instance, plays a crucial role in the political landscape and peacekeeping efforts in

Bosnia and Herzegovina, particularly following the Dayton Peace Agreement (DPA) established in November 1995 ("the current Constitution of Bosnia and Herzegovina is the Annex 4 of the DPA", OSCE, 1995). American tourists visiting Bosnia and Herzegovina frequently express their admiration for its natural and cultural attractions; for example, Johanson (2014) highlighted it in the media (International Business Times) as an intriguing destination worthy of a visit. Furthermore, all three target regions are home to a significant part of the Bosnian-Herzegovinian diaspora, whose residents are repeat visitors to Bosnia and Herzegovina. Notably, individuals from the Serbian and Jewish communities tend to come from Western Europe and Canada, while those from the Bosniak and Croatian communities are more likely to originate from the USA or central and northern EU countries.

In the realm of business and marketing across various markets, Balkantina and Sarajevo Insider are the most prominent (Fig.23). Balkantina uniquely promotes in neighboring countries, whereas Touredo exclusively targets the Malaysian market. Notably, tour operators did not reference any promotional activities in the GCC and Mediterranean markets, attributing this to the lower demand for their services in those regions.

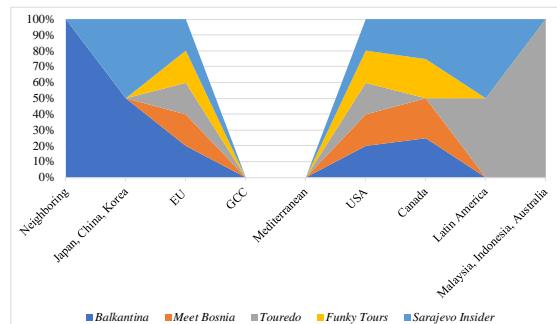


Fig.23. Targeted tourism markets for specific inbound tour operators
(Own research)

The most effective channels for distributing tourism products include recommendations, international fairs, and the internet (Fig.24). Recommendations serve as a powerful promotional tool within the tourism sector, where trust is paramount, and satisfied customers often become brand ambassadors, aiding in the product's popularization. International fairs facilitate direct interaction with potential clients and partners, while contemporary technologies and digital platforms, particularly social networks, allow for direct communication and the efficient dissemination of information, thereby enhancing the accessibility of tourism offerings to a broader audience. Private distribution channels are less prevalent and may include exclusive offers that agencies, for instance, do not provide online, whereas traditional media channels represent the smallest segment in the advertising efforts of inbound tour operators and their methods of reaching clients.

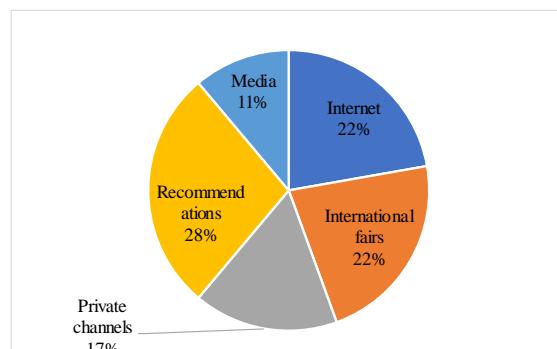


Fig.24. Sales and promotional distribution channels for tourism products
(Own research)

In the framework of offer promotion among individual inbound tour operators (Fig.25), only Balkantina employs all available forms of promotion, whereas Touredo, for instance, depends solely on internet channels and recommendations.

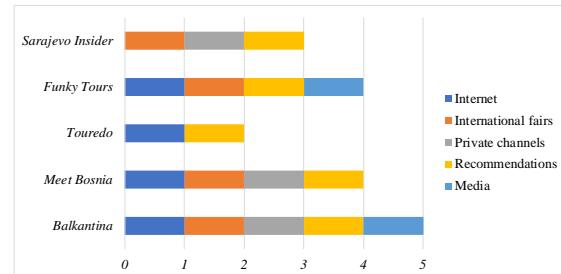


Fig.25. Distribution channels of tourism products for specific inbound tour operators
(Own research)

The main elements contributing to competitiveness and sustainability within the tourism market include the variety of offerings, particularly genuine tourist products, as well as their affordability and popularity, among other factors. In contrast, elements like seasonality, ISO standards, and eco-certification exert a relatively minor influence (Fig.26). This underscores the necessity to concentrate on creating distinctive experiences and a wide range of choices for travelers to enhance the appeal of the destination.

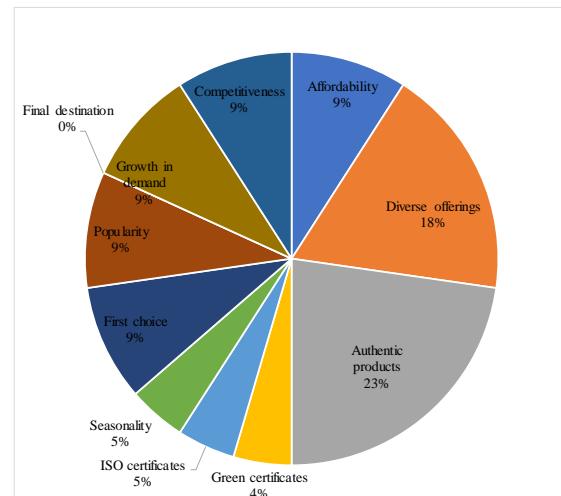


Fig.26. The competitiveness at the market- the sustainability of the tourism product
(Own research)

The competitiveness of the offerings provided by individual inbound tour operators (Fig.27) mainly encompasses authentic tourism products, yet it does not consider the Sarajevo Canton as the ultimate destination – the primary location for visitors' stays. Two out of five tour operators indicated that this destination is the preferred choice for visitors, which they view as an advantage (Meet Bosnia and Funky Tours). However, only one tour operator (Funky Tours) regards ISO and eco-certifications as significant for the sustainability of the tourism product.

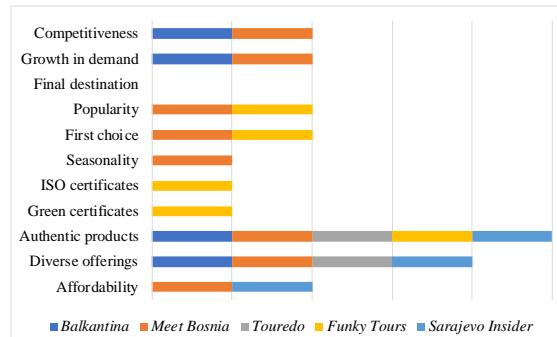


Fig.27. Competitiveness – sustainability of the offerings at specific inbound tour operators
(Own research)

Meet Bosnia is the most prominently featured in the composition of a competitive and sustainable tourism product (Fig.28), as it showcases the highest number of elements that enhance that segment, whereas Touredo is the least represented, concentrating on the variety of offerings and authentic tourism products.

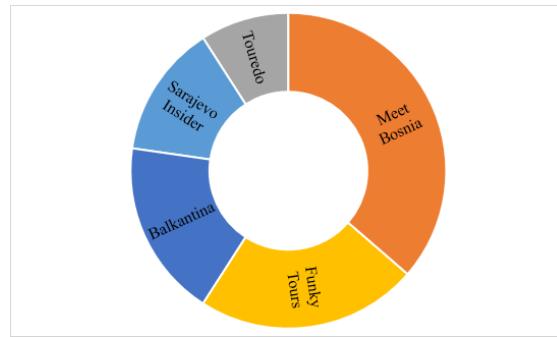


Fig.28. Participation of inbound tour operators in the sustainability of the tourism product
(Own research)

All five inbound tour operators are experiencing a favorable business trend (Fig.29) characterized by a rise in demand for tourist services, an expansion of offerings, and the emergence of new markets.

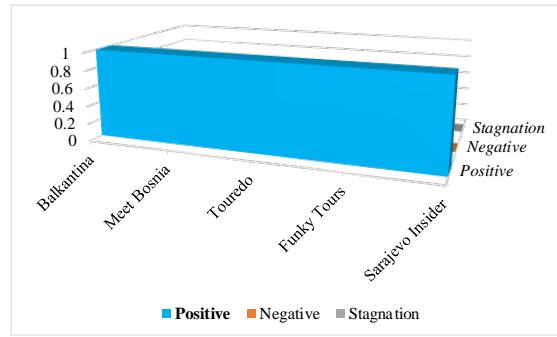


Fig.29. Business trend of inbound tour operators
(Own research)

This positive development can be attributed to effective marketing strategies, alongside the growth of tourism in Bosnia and Herzegovina, which has seen an increased influx of foreign tourists, an enhancement in the quality of offerings, and a growing popularity of the destination.

4 Conclusions

The significant contribution of inbound tour operators in Sarajevo to tourism, spatial, and social development has been recognized through their initiatives in creating, promoting, and selling a diverse range of authentic domestic and local tourism products to international visitors and foreign tourists. The most

prominent offerings include urban, gastro, and cultural tourism, along with religious and nature tourism. These tour operators enhance international and cultural collaboration by actively engaging in promotional events such as international fairs, primarily focusing on the tourist markets of the European Union, the USA, and Canada; consequently, a considerable number of clients utilizing their services originate from these regions. Moreover, tour operators play a vital role in strengthening cooperation with various stakeholders, primarily depending on established partnerships with traditional entities such as hotels and transport companies, while also collaborating with the cultural and natural heritage sectors. All five inbound tour operators are witnessing positive business trends, which not only bolster sustainable local economic development but also contribute to the national economy, as numerous tourism products are consumed in areas beyond the cantonal region, generating income and tourist activity in those locations.

Nevertheless, while tour operators in Sarajevo Canton play a crucial role in the development of both urban (dominant) and rural tourism (lesser), several challenges confronting this destination have been recognized. For instance, a minimum stay of less than three days is noted for the majority of inbound tour operators, whereas stays of three to seven days are less frequently observed. Moreover, the GCC was not recognized by tour operators as a target market for promotion or in the classification of tourists by arrivals, despite the fact that these travelers, along with those from the USA, the EU, and neighboring countries, tend to have the longest stays at the destination. According to official statistics from the Statistical Agency of Bosnia and Herzegovina (2025), the Institute for Informatics and Statistics of the Sarajevo Canton (2024), and the Economic Institute Sarajevo (2024), in conjunction with prior field research that included interviews with hotel managers and tourism officials (Žunić, 2018), our documented findings (Fig. 4) reveal that wealthy Arab tourists from GCC countries, such as the Kingdom of Saudi Arabia, enjoy the longest average stays in Sarajevo Canton, which can extend up to three months or even a year. This observation is equally relevant at the national level, as the longest stays in Bosnia and Herzegovina (exceeding three nights) are primarily linked to tourists from Kuwait, Qatar, and the United Arab Emirates, among others (according to data from the Agency for Statistics of Bosnia and Herzegovina, 2025). This situation highlights the necessity for the development of prioritized tourism policies at both the national and cantonal levels, along with the strategic business frameworks of inbound tour operators, to effectively plan promotional activities aimed at this specific geographic region, as well as to customize offerings to align with the unique preferences of this established clientele within the global tourism industry.

Given that travelers originating from Gulf Cooperation Council (GCC) nations do not engage the services of inbound tour operators in Sarajevo, it is imperative to enhance connectivity with the tourism market in that particular region of the world, while concurrently ensuring the provision of halal tourism offerings. The availability of certified services within tourist destinations holds significant importance for affluent clientele from Gulf nations: opulent hotels and dining establishments that adhere to halal business principles, tourist resorts staffed by individuals proficient in Arabic, as well as permissible tours encompassing natural or cultural attractions, which must include Islamic religious sites and cultural events specifically designed for visitors who practice the Muslim faith.

The issue of brief registered stays in Sarajevo is frequently associated with the grey economy, which necessitates intervention from the authorities through more efficient strategies such as surveillance of unregulated accommodation and transport providers. Additionally, it is important to enhance public awareness regarding their responsibilities, complemented by media coverage about the substantial penalties involved.

The brief visits noted by tour operators can also be associated with the focus on Sarajevo Canton as a transit point in promotional activities. The lack of strong collaboration with

airlines and foreign investors suggests a deficiency in commitment towards the advancement of inbound tourism, where Sarajevo Canton should ideally serve as a primary destination rather than merely a city-break destination. Likewise, the relatively neutral partnerships with ministries and municipalities reflect a stagnation in the exploration of geographical areas and a lack of progress in enhancing the tourist offerings, as new resources and tourist zones ought to be developed in consultation with government officials. It is crucial to strengthen the connections between inbound tour operators and these institutions for the purpose of regulation and support, as well as for collaborative innovative development initiatives in tourism. Notable landscapes, including theme parks, horticultural sites, and historical landmarks, along with nearby rural tourist attractions featuring rustic styles or natural areas equipped with eco-hotels, constitute appealing components of tourist infrastructure in regions intended for extended stays. Renowned international events, such as concerts by global icons like Madonna, or nightlife venues offering social activities like karaoke or bowling, also play a significant role in increasing attendance and prolonging stays in urban locations.

In the classification/ typology of tourists, the original geographical background of foreign visitors was overlooked, despite the fact that it is acknowledged within the industry that a significant portion of tourists from the USA, Canada, and the EU belong to the Bosnian diaspora. This aspect should be considered when developing thematic products related to diasporic tourism. Diasporic tourism plays a crucial role in revitalizing culture and reconnecting individuals with their roots, as well as promoting romantic tourism, which involves seeking partners from one's homeland. This necessitates the creation of innovative products, including special events, workshops, and matchmaking services. Furthermore, it is vital to recognize the connection between tourism and health, as many diaspora visitors opt for private healthcare services in their home country at more affordable rates (Žunić et al., 2024). Diasporic tourists can also be classified under the VFR category, as they are often motivated by visiting family or relatives in their place of origin. However, this type of tourism is often unacknowledged by inbound tour operators, highlighting the need to establish a comprehensive database that profiles visitors who utilize tourism services in the destination, along with their primary motivations or purposes for visiting.

Given that families are the primary consumers of inbound tour operator services, it is essential to tailor the offerings to meet their needs. Families with children tend to favor a greater number of attractions and events at their destination, which provides a solid foundation for organizing a longer and more engaging visit to the Sarajevo Canton.

Among the most prevalent tourist offerings as products in the Sarajevo Canton, rural tourism has not been emphasized by tour operators, despite the "favorable conditions for its clear integration into the tourism supply" ("Tourism Development Strategy of Canton Sarajevo until 2030- Draft", Economic Institute Sarajevo, 2024). The anticipated interest in this sector could notably come from family tourists (Žunić, Demir, & Ravlić, 2024). Nevertheless, while agencies primarily promote rural excursions through social media aimed at local residents, tour operators often lack a clear presentation of rural tourism options for international visitors (due to inadequate information). Consequently, they resort to arranging private tours at elevated prices, which hampers the potential for commercial growth in this area. For instance, a day trip to the village of Lukomir, including a scheduled tour and private transportation for 2-4 individuals, is priced at 300 EUR. This effectively "privatizes" the rural tourism offering in Sarajevo Canton, creating a notable obstacle to its accessibility and limiting its potential demand.

Similarly, specialized products associated with event and health tourism have been overlooked, making it essential to enhance the promotion and organization of international events, in addition to expanding capacities in the areas of sports, entertainment, and health.

Tour operators have failed to acknowledge the affordability of prices in the Sarajevo Canton as a crucial competitive factor. In comparison to their primary clientele, which includes individuals from the USA and the EU, this aspect should be prominently emphasized. These clients originate from a significantly more developed world with a higher standard of living, which is accompanied by considerably higher prices than those found in Bosnia and Herzegovina. Furthermore, many services in Sarajevo are more reasonably priced than those in the capital cities of neighboring nations.

The competitive limitations of the Sarajevo Canton's tourism offerings stem from its failure to be recognized as a primary destination, coupled with the absence of ISO and eco-certifications for the products available in the market.

Future strategies and objectives for the development of tourism in this destination should focus on adapting to the evolving demands of the tourism market. These demands necessitate that a destination provides a wide array of diverse attractions, which should include as "many protected natural and cultural sites as possible (IUCN, UNESCO), in addition to hotels and restaurants that possess well-known eco and halal certifications, as well as ethno-villages and open-air museums located in close proximity" (Žunić, Bidžan-Gekić, & Gekić, 2019; Žunić, Kosić, & Pivac, 2023; Žunić, 2024; Žunić: 2022b, 2023). Furthermore, it is crucial to establish conditions and channels that attract foreign investors for innovative spatial research and infrastructure development. Additionally, designing action plans is crucial to enhance collaboration with airlines, enabling the Sarajevo Canton to connect more effectively with the global community and position itself as a primary choice or final destination. Inbound tour operators ought to invest more significantly in international relations and develop tourism business priorities and strategies in a more comprehensive manner, as they are instrumental in promoting local destinations to international markets. Collaborative efforts between inbound tour operators and airlines are vital for creating more competitive offerings, boosting passenger traffic, and generating revenue. Moreover, partnerships with foreign investors can supply the necessary capital for infrastructure development, enhance the destination's competitiveness, and attract a greater number of international visitors, thereby benefiting the national tourism sector.

One of the primary objectives of sustainable tourism in the Sarajevo Canton should be to enhance the network of inbound tour operators. The entities discussed are conditionally categorized as tour operators in this analysis, yet they are predominantly registered as agencies—often due to lower tax rates and less stringent inspection oversight—resulting in a significantly reduced responsibility and functional role in the tourism development of the destination. The findings reveal a substantial reliance of inbound agencies on tour operators, a more neutral relationship with authorities, diminished cooperation among stakeholders, a static supply, and a less dynamic research approach within the destination. At present, outbound agencies outnumber inbound ones, with domestic tour operators playing a minor role, which is unsustainable for the growth of receptive inbound tourism. Given that tour operators are essential in researching geographical areas to enhance tourist infrastructure and offerings, the canton should implement support measures and programs aimed at educating local tourism entrepreneurs, thereby creating more favorable conditions to foster the growth of inbound tour operators in the destination.

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