



# CELEBRATING SCIENCE: E<sup>3</sup>UDRES<sup>2</sup> SCIENCE FESTIVAL

## SOCIETY. TECHNOLOGY. SOLUTIONS

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## Foreword



**Ieva Zaumane**, Vice-Rector for Academic Affairs,  
Vidzeme University of Applied Sciences

### Dear Readers,

It is a pleasure to present the abstract proceedings of the Student Research Conference. This volume brings together the work of young researchers who have taken the important step of sharing their academic findings in a written, structured, and lasting form.

The pages that follow reflect both the diversity of topics and the dedication of our students. We are especially pleased that this collection includes contributions from international students, making the publication a true meeting point of ideas, perspectives, and cultures.

These proceedings are more than a record of student presentations—they are a showcase of curiosity, creativity, and critical thinking. Each paper represents a step forward in developing the skills that will support future academic and professional achievements.

I would like to express my sincere gratitude to all students for their efforts, to their supervisors for their guidance and support, and to the organizing team, whose commitment made this conference and publication possible.

I warmly invite you to explore this collection with an open mind. May it serve not only as a source of knowledge, but also as inspiration for further inquiry, dialogue, and collaboration.



The E<sup>3</sup>UDRES<sup>2</sup> Science Festival at Vidzeme University of Applied Sciences (ViA) appropriately begins with the Student Research Conference, emphasizing the significance of engaging with ideas generated by young individuals who are not yet constrained by years of accumulated experience. Preceding the week's conclusion—the E<sup>3</sup>UDRES<sup>2</sup> Stakeholders' Forum involving critical evaluation by cooperation partners and industry professionals—participants will engage in a series of diverse discussions on pressing contemporary issues. These include the development of start-ups and strategies for attracting human capital, city marketing and innovative tourism offers, the socio-economic legacy of Soviet military infrastructure, media consumption patterns and influencer culture, augmented reality and gaming, among other relevant topics.



**Iveta Putniņa**, Vice-Rector for Development & E<sup>3</sup>UDRES<sup>2</sup> European University Alliance Site Coordinator at Vidzeme University of Applied Sciences

Science Festival offers an exceptional context for experimentation, learning through failure, and refining ideas. For ViA community, the European University Alliance E<sup>3</sup>UDRES<sup>2</sup> serves as a vital platform for co-creation and support. This partnership provides access to a network of trusted collaborators—academic staff, industry experts, and students—facilitating dialogue on complex and emerging issues.

The event presents a unique opportunity to test whether one's idea, research question, or product can withstand critical scrutiny from representatives of eight other European countries. Within such a dynamic and collaborative environment, ideas inevitably evolve—they must be refined and adapted, which is essential for meaningful development.

May each participant succeed in identifying the topic that inspires them to excel, and may they retain the resilience to persevere—through setbacks and successes—until achieving the highest possible standard of their work.

# **The 14<sup>th</sup> Student Research Conference**

## **SOCIETY. TECHNOLOGY. SOLUTIONS**

### **Presentations on 15 October 2025**

## Use of Games in Human Resource Management

**Gustavs Māziņš**, Vidzeme University of Applied Sciences, Valmiera, Latvia

The bachelor's thesis explores the use of games in human resource management (HRM), focusing on the potential of erudition games as a tool for team development, employee training, motivation, and engagement. In recent years, games have increasingly been used not only for entertainment but also in professional environments. In these contexts, gamification—the application of game elements in non-game contexts—is gaining recognition as an effective strategy to support learning and collaboration in organisations.

The objective of the present study is twofold: firstly, to evaluate the potential of employing games in HRM processes in Latvian organisations within a global framework; and secondly, to assess the practical use of the erudition game "Zini! Mini! Uzzini!". The game, which was created and developed by the author, has been implemented in over 30 organisations across Latvia since 2023, including educational institutions, hospitals, public services, and private enterprises. The objective of the present study is to formulate concrete proposals for human resources specialists to integrate such tools into their management and training strategies.

The theoretical component of the thesis encompasses a review of classical and alternative HRM theories, key motivation and learning theories, and gamification concepts. The discussion focuses on the potential of games and game-based elements, including point systems, immediate feedback, levels, and competitive dynamics, to enhance employee motivation, improve knowledge retention, and support cooperation. Furthermore, five models from game theory are analysed (e.g., Trust Game, Ultimatum Game, Stag Hunt), demonstrating how strategic decision-making frameworks can be adapted to HRM challenges.

The empirical element of the study incorporates structured interviews with human resources managers and administrative staff from nine organisations that have utilised the game "Zini! Mini! Uzzini!", as well as surveys involving 100 employees. The findings indicate a favourable influence of the game on team communication, collaboration, and overall engagement. The respondents emphasised enhanced mutual comprehension, elevated engagement during the game, and a propensity to engage in analogous activities in the future. It is evident that certain organisations have already adapted the game to incorporate specific content related to their internal strategy or work regulations. This suggests that erudition games can also serve as effective tools for knowledge transfer and onboarding.

The study concludes that the game "Zini! Mini! Uzzini!" is not only a valuable team-building instrument but also has the potential to become an integral part of HRM processes, especially in areas such as employee onboarding, internal communication, and compliance training. While traditional methods of instruction, such as lectures and seminars, continue to be significant, erudition games provide a complementary, interactive format that fosters both cognitive and social engagement.



The following key challenges have been identified: the necessity for content customisation, the requirement to balance knowledge levels across teams, and the importance of ensuring that facilitators can effectively manage game dynamics. Nevertheless, the study confirms that well-designed and goal-oriented games can contribute significantly to strategic HRM and foster a more cohesive and motivated workforce. Proposals for game developers and HR specialists include the provision of ready-made game templates, the promotion of co-creation of content, and the development of interactive tools that support long-term implementation in organisations.

This thesis contributes to the expanding field of gamification in human resource management. It provides a practical guide for organisations in Latvia and beyond on how to integrate game-based methods into their personnel development practices.

**Keywords:** human resource management, games, gamification, erudition games

## **Factors Influencing Youth Participation and the Role of Communication in Volunteer Work in Latvia**

**Adrija Raiveta Kaire**, Vidzeme University of Applied Sciences, Valmiera, Latvia

Volunteering is more than just helping others – it is an opportunity to develop skills, build citizenship, and promote social well-being. Although the most active volunteers are young people aged 15 to 25, data from the Society Integration Foundation in Latvia (2021) show that only 24% of young people fully understand the concept of volunteering, and 69% have never participated in such activities. This highlights the urgent need to raise awareness of the factors and communication strategies that can motivate young people to engage in volunteering. The present study addresses this gap by analyzing the factors that promote youth participation and examining the role of communication in shaping their motivation, while also offering practical recommendations for volunteer organizations. The study aims to examine the key factors influencing youth participation in volunteering in Latvia, with a particular focus on motivational drivers and the role of communication.

Two main research questions are defined: (1) What are the main factors that influence young people's participation in volunteering in Latvia, particularly in terms of motivation and engagement? (2) And what communication strategies are currently employed by organisations to encourage youth involvement in volunteering, and how effective are these strategies perceived to be?

The study adopts the qualitative research design and was conducted between 1 and 30 November, utilizing semi-structured interviews. The ten interviews were conducted both remotely and in person with participants aged 18 to 25. In total, 15 volunteers and 7 volunteer organizations were interviewed. The data were analyzed using thematic analysis, whereby the interview transcripts were coded and categorized according to the themes identified in the theoretical framework.

The findings indicate that volunteering serves as a valuable mechanism for both community development and individual growth.

It facilitates the acquisition of essential life skills, including leadership, empathy, and self-efficacy, thereby contributing to both personal and professional development. Volunteering also strengthens social identity and fosters a sense of belonging, which is critical for sustained engagement in societal processes.

Trust and cooperation emerge as key elements in maintaining long-term involvement, with the relationship between the volunteer and the organization playing a pivotal role.

Teamwork and mutual trust enhance emotional fulfillment and motivation, autonomy and recognition significantly contribute to volunteers' self-esteem and sustained commitment.

Communication is vital for successful cooperation: clear channels and regular communication improve organizational efficiency and volunteer engagement. A supportive and safe environment

that values volunteer input fosters a sense of belonging and importance. The broader impact of volunteering is its ability to shape responsible, socially active citizens who better understand societal needs and challenges. In conclusion, trust-building and a positive environment are foundational for effective volunteer team communication. Personal growth and skills development are significant motivators, while cultural awareness and language proficiency affect engagement levels. Effective communication practices are key to organizing and sustaining volunteering activities. Communication links the benefits of volunteering with outreach and recruitment efforts, making communication skills essential for all involved. Based on these findings, it is recommended that organizations implement regular feedback systems to sustain motivation and engagement. They should develop communication strategies that combine professional guidance with personal connection. Digital tools and platforms should be used to enhance coordination and accessibility. Long-term involvement can be supported through recognition programs that value volunteer contributions. Youth programs should emphasize personal and skills development, while intercultural training should be introduced to reduce barriers and foster inclusion.

**Keywords:** volunteering, youth engagement, motivation, participation factors

## **Factors That Promote Science-Based Pedagogical Approach in Secondary Education in Latvia**

**Katrina Kūkuma**, Vidzeme University of Applied Sciences, Valmiera, Latvia

The aim of the study is to investigate the science-based pedagogical practice of teachers and its facilitating factors in secondary education institutions in Latvia. Science-based pedagogical practice in Latvia has not been studied so far, and there is a lack of data on such practice in schools. The study surveyed 579 teachers on the following topics: professional development, scientific practice in schools, science-based pedagogical practices, scientific literacy, consumption of scientific content, and attitudes towards science. The results demonstrate that active consumption of scientific content ( $\beta = 0.30$ ,  $p < 0.001$ ) is the most significant factor explaining science-based pedagogical practice, the second most significant is a positive attitude towards science ( $\beta = 0.23$ ,  $p < 0.001$ ), statistically significant factors are also scientific practice at school ( $\beta = 0.11$ ,  $p < 0.05$ ) and lack of understanding of science ( $\beta = -0.11$ ,  $p < 0.01$ ).

**Keywords:** science-based pedagogical practice, scientific literacy

## Media Diet of Latvia's Non-Citizens

**Sergejs Bičkovs**, Vidzeme University of Applied Sciences, Valmiera, Latvia

Latvia's non-citizens are mostly representatives of other ethnicities who immigrated to the territory of Latvia during the Soviet era, and they continue to be a large part of Latvia's society, making up around 10% of the population; however, they cannot participate in the political life of the country. Due to the origin of non-citizens, there used to be an idea among researchers that non-citizens are part of the Russian information space, and there are two information spaces in Latvia. However, recent studies have called for a broader look at the topic, calling for studying not only the choice of language, but also the ethnolinguistic identity, choice of content, and the impact of age on the media diet of non-citizens. Since most studies in the last 10 years focused on minority media consumption and grouped non-citizens with ethnic minorities, the author has observed a lack of research on non-citizens.

The study used a qualitative research strategy. Semi-structured interviews were conducted with non-citizens of Latvia of different ages to collect data. The qualitative thematic analysis method was used to analyse and describe the data. The obtained audio recordings were transformed into transcripts, which were later processed. The processed transcripts were initially coded line by line to get an idea of the content of the transcript. After the first round of coding, the codes were further processed and later highlighted and sorted by theme and type of media user.

It was possible to reveal that the most significant differences in media consumption among non-citizens were between passive and active media users. Passive media users consumed media content less, distrusted it more, avoided media in the Latvian language, and did not check the information they received, because they did not believe that it was possible to find out the truth. Active media users, who mostly combined active and passive media content consumption, have tried to check the information they received more actively, trusted the media more, and showed a greater diversity of media consumption, both by choosing different types of media and media in multiple languages. Latvia's non-citizens, despite the blockage of Russian media in Latvia, find ways to continue consuming Russian media content. Social media is becoming an increasingly vital source of information and the news for non-citizens of all ages. Latvia's public media content was not engaging for Latvia's non-citizens; however, non-citizens consumed Latvian media content as their main source of information. Latvia's non-citizens chose Latvian media more; however, they still did not see sufficient content in Latvian or Russian that suited their interests.

The study revealed that Latvia's non-citizens do not live in a "separate information space", as they continue to simultaneously consume Latvian media content and Russian media content and retain interest in what is happening in Latvia, and are mostly not interested in what is happening in Russia and do not identify themselves as belonging to Russia. Due to the fact that Latvia's non-citizens are unable to find content of interest to them either in Latvia's public media or in Latvian commercial media, after the blocking of Russian media, the majority of non-citizens «migrated» from traditional media, i.e. television, radio and print media, to social media and the Internet - it is precisely social

media and the Internet that have become the main sources of information for non-citizens. Additionally, with the help of social media and the Internet, Latvia's non-citizens can access blocked Russian media content, as it is legally and freely available on social media such as "YouTube", "Telegram", etc.

Traditional media should study the interests of different groups in society more and learn to communicate with a diverse audience on social media better, in order to reach a broader audience and interest them in consuming different media products, as well as try to reach non-citizens of Latvia and increase their level of trust in Latvian media.

**Keywords:** media diet, information space, non-citizens



## **Social Media Influencers and Relationship Monetization With Their Audience**

**Annija Beire**, Vidzeme University of Applied Sciences, Valmiera, Latvia

The purpose of this study was to explore the audience's point of view on influencers' behaviour monetizing parasocial relationships with them. This topic is currently important as the influencer market has increased in the last few years. A qualitative research design was chosen, with a total of 12 participants taking part in semi-structured interviews. For data analysis, thematic analysis was chosen. Findings show that not all participants have developed a strong parasocial relationship with the influencer; for some of them, the relationship is of a lower intensity. It has been found that participants do not have a clear view of influencers' advertisements. This can be closely linked to parasocial relationships; when they are stronger, the more positively an ad is perceived. There is one element that connects all the participants - an understanding of the influencer's business model. Social media platforms have a meaning when it comes to how followers view influencers' advertisements. The social media platform *TikTok* has been considered the best because, as participants find it, it is easier to skip advertisements, a warning is included about the advertisement, and the algorithm is more suitable.

**Keywords:** parasocial relationship, influencers, attitude, social media, monetization

## **Image Distance Judgement and Visual Comfort in Augmented Reality**

**Edvards Apsītis**, Tatjana Pladere, Gunta Krūmiņa, University of Latvia, Riga, Latvia

### **Significance of the topic**

Accurate perception of image location relative to the physical environment, along with the absence of visual discomfort, is fundamental for the effective use of optical see-through augmented reality in professional applications. However, user experience can be negatively affected when using conventional augmented reality headsets, with perceptual biases (Gabbard et al., 2019) and visual strain (Roberts & Christian, 2024) User observed in some users. Reliable assessment methods for these parameters are therefore required.

### **Purpose of the research**

The aim of this study was to evaluate a set of tools for assessing image distance perception and visual comfort in optical see-through augmented reality, with a focus on their suitability for repeated measures. For this purpose, a distance matching task and a visual strain questionnaire were employed.

### **Methodology**

Forty-one participants (mean age: 23 years) with normal binocular vision took part in the study. An optical see-through augmented reality headset (IG-1050, Lightspace Technologies) was used to present images at a focal distance of 50 cm. Image distance judgments were done within a matching task in which participants manually adjusted a physical pointer mounted on a sliding carriage to align it with the perceived distance of the image. To assess changes in comfort, participants completed a visual strain questionnaire before and after each set of six visual acuity trials conducted in augmented reality. The visual acuity tasks were performed under three display luminance conditions: 200, 300, and 400 cd/m<sup>2</sup>.

### **Main results**

In most cases, participants slightly overestimated the distance of images in augmented reality. However, distance underestimation occurred more frequently when the display luminance was 400 cd/m<sup>2</sup>. Notably, individual differences were observed in judgment accuracy, with some users demonstrating improved performance over successive trials. Across all participants, no difficulties were reported when using the distance matching device.

Regarding comfort, the results revealed considerable individual variability in symptoms. Some participants experienced a slight increase in eye fatigue and dryness, particularly under lower luminance conditions. Interestingly, higher luminance conditions were associated with less

frequent reports of eye fatigue; however, other symptoms, for example, burning sensation in the eyes, were occasionally reported. It is important to note that the overall intensity of symptoms was generally mild, with only a few cases rated as moderate. The questionnaire enabled a quick and accessible assessment of the most common symptoms associated with the use of displays. However, it did not include the full range of potential changes in visual comfort, and participants reported additional observations.

## Conclusions

It was shown that the combination of a distance matching task and a visual strain questionnaire could be used to assess visual perception and comfort in optical see-through augmented reality. However, further investigation is required. Image distance overestimation could be influenced by the chosen assessment procedure, visual-motor biases, and the physical properties of the pointer used. Future work should also consider expanding the comfort assessment framework, including refining the selection, number, and variety of symptoms evaluated. Further methodological development is required to thoroughly determine whether individual users can use augmented reality and under what conditions.

## Acknowledgments

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**Keywords:** depth perception, augmented reality, comfort

## **Startup Development in Latvia: Influencing Factors and Trends**

**Ervins Boikovs**, Vidzeme University of Applied Sciences, Valmiera, Latvia

Startups play an important role in fostering competition and contributing to national economic growth, their activities promote the creation of well-paid jobs, the development of new and innovative business ideas, as well as the creation of high value-added products and services.

However, since 2021, there has been an 81% decrease in annual registered startups, and fewer startups have been registered each year. Likewise, the amount of venture capital attracted by startups in Latvia has been the lowest among the Baltic states – both in terms of the number of deals and the total investment volume. The aim of the study was to examine the development of startups in Latvia, identify the main factors influencing their growth, and develop proposals to promote startup development and improve the support ecosystem.

The study applied several methods: theoretical literature analysis was applied to examine start-up definitions, classifications, life cycle stages, funding sources, and ecosystem elements. Statistical data analysis was used to evaluate start-up performance indicators in Latvia over a three-year period and investment trends in the Baltic region over the past 10 years. Document analysis was conducted to review the Latvian start-up development strategy and related policy documents. Empirical data collection included a survey of Latvian start-up founders and representatives (carried out from April 10 to May 10, 2025) and semi-structured interviews with investors and key ecosystem stakeholders (conducted from April 7 to May 12, 2025). The main data sources used in the study were the Startin.lv database (with 515 registered start-ups as of April 1, 2025), Change Ventures, Startup Lithuania and Startup Estonia.

The study concluded that the main factors influencing startup development are insufficient funding availability in the early stages, limited investor interest, challenges in attracting qualified talent, an underdeveloped support ecosystem, and a lack of experience.

The study identified several long-term trends in the development of startups in Latvia – an annual decline in registration rate, an increase in the number of closed companies, a rise in the average age of founders, reduced investment activity, and a more selective investor approach.

Despite these challenges, there are also positive development trends, related to the growth of venture capital funds, targeted capital instruments for early-stage startups, the emergence of a “give-back” culture, and the restructuring of ecosystem participants.

To address current barriers and support future growth, the study proposes several measures: improving access to early-stage capital, creating targeted financial instruments, fostering international talent recruitment, encouraging cross-sector collaboration, and enhancing mentorship and knowledge-sharing within the ecosystem. Improved coordination among ecosystem

players and more transparent data-sharing are also recommended to support informed decision-making.

**Keywords:** startup, ecosystem, support, influencing factors, development, trends

## **Attracting Qualified Labor to Aluksne Region**

**Santa Skaistkalne**, Vidzeme University of Applied Sciences, Valmiera, Latvia

The socio-economic development of Aluksne region is affected by a lack of qualified labor. The town continues to develop, but the population continues to decline, and the region is impacted not only by a long-term demographic downturn but also by population migration, resulting in a reduced available workforce and difficulties for local entrepreneurs in finding employees with appropriate qualifications. Qualified employees drive innovation, productivity, and economic development. Investments in education, training, and continuous skills development are very important for both individuals and organizations to remain competitive in a rapidly changing world. Labor market dynamics show that demand for qualified specialists will increase in sectors affected by technology. It is essential for Aluksne region to attract and retain educated and motivated professionals. Aluksne region must create an attractive environment for potential specialists by investing in education and creating favorable labor market conditions.

The aim of the thesis was to examine the current situation of qualified labor in the labor market of Aluksne region to determine labor availability and the influencing factors, as well as to develop proposals for labor attraction. To achieve the aim of the thesis, the author applied the monographic research method to study internet resources and theoretical literature sources on the labor market and the significance of qualified labor in the economy. The empirical research method was applied in the thesis to conduct surveys of residents, pupils, students, and graduates. In addition, interviews were conducted with entrepreneurs of Aluksne region and the Aluksne municipal government. To compile and analyze the data obtained from the surveys and interviews, the author also used the method of statistical data analysis.

In the theoretical part, the author describes the essence of the labor market and the factors influencing the attraction of qualified labor. The research part analyzes the availability of qualified labor in Aluksne region in the context of the Latvian labor market. The author analyzes the opinions of entrepreneurs and municipal representatives on aspects of labor attraction and develops proposals for attracting qualified labor. After the territorial reform, Aluksne region is the sixth smallest in terms of population. The main development directions of the region are twofold – manufacturing and tourism. In Aluksne region, the number of working-age residents is decreasing, while the demand for employees with diverse knowledge and the ability to quickly adapt to new conditions (for example, digital skills and green technologies) is increasing. Mobility is another significant challenge that needs to be addressed – the distance from rural areas to the town of Aluksne or to workplaces complicates mobility and reduces attractiveness for new residents. Unemployment rate in Aluksne region is higher than the national average in Latvia. Development in Aluksne region is uneven – outside the town, wages are lower, and employment opportunities are more limited. In the conclusion of the thesis, the opinion of young people in Aluksne region regarding their future intentions and willingness to live and work in the region is clarified.

As a result, it is evident that in Latvia there is a growing demand for qualified specialists, while the education system and demographic factors are unable to ensure such a rapid supply of labor therefore, more employed individuals are choosing lifelong learning. Likewise, entrepreneurs in Aluksne region retain qualified labor using various approaches – material motivation, improvement

of quality of life and recognition. Residents who work outside Aluksne region are more satisfied with their jobs than those working within the region, indicating that other regions offer higher salaries, broader career development opportunities, and better working conditions. Factors influencing whether young people stay in or return to Aluksne region include well-paid jobs, housing availability, and the possibility to work in a profession that aligns with their personal interests.

To ensure sustainable human resource development and respond to labor market challenges in Aluksne region, it is necessary to establish a lifelong learning center that would be adapted to the needs of the labor market of the region. In addition, it is recommended to create a work coordination group for the publication of updated information. The development of a program aimed at attracting young specialists would also be significant. Such measures would make a substantial contribution to the development of the region's human capital.

Keywords: qualified labor, attraction, factors, Aluksne region

## **City Marketing as a Promoter of Sustainable Development and Local Entrepreneurship Growth in the City of Cēsis**

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The bachelor's thesis "City marketing as a promoter of sustainable development and local entrepreneurship growth in the city of Cēsis" explores the strategic role of city marketing in supporting local economic development and integrating sustainability principles into urban planning. Currently, cities are not only competing for tourists, but also for talent, investment, and reputation. As global problems like climate change and inequality grow, cities are expected to act. City marketing is no longer just about promotion – it also helps shaping how cities develop, how they are seen, and how they involve the local community and businesses.

Cēsis, a historical and culturally vibrant city in northern Latvia, provides a relevant case for analyzing the connection between city marketing, sustainable development, and entrepreneurship. The city has positioned itself around values such as creativity, nature, innovation, and cultural heritage. It has implemented several strategic documents emphasizing sustainability, including the Cēsis Municipality sustainable development strategy for 2022-2036, the Cēsis Municipality integrated sustainable energy and climate action plan until 2030 and the bioregion management model. However, while the city demonstrates strong ambitions on paper, the actual impact and coherence of its marketing efforts in supporting local business development remain underexplored.

The aim of the bachelor's thesis is to research the marketing activities of the city of Cēsis, aimed at the sustainable development of the city and the promotion of local entrepreneurship, and to provide recommendations for the improvement of activities. Interviews with local entrepreneurs suggest that the marketing strategy lacks a strong business-oriented component, and collaboration with the entrepreneurial community is fragmented and insufficiently structured.

To reach the aim, four methods were used: literature review and theoretical framework analysis of city marketing, sustainability, and entrepreneurial development; secondary data analysis of strategic plans, previous studies, and statistical indicators; structured interviews with local entrepreneurs, municipal representatives, and external experts to gather firsthand insights into the relationship between marketing and local business support; and a case study analysis that evaluates implemented initiatives in Cēsis and benchmarks them against successful practices in other cities, such as Freiburg and Malmö.

The findings highlight that while the city's brand is built around sustainability values, the marketing strategy lacks a systematic focus on the needs and challenges of the business community. Key interview insights reveal that entrepreneurs recognize the city's strengths, particularly in environmental messaging, community involvement, and cultural identity, but they also highlight weaknesses such as a lack of targeted marketing campaigns and weak collaboration structures. Marketing efforts related to entrepreneurship are less developed and not as consistent as those



focused on tourism. Communication channels are scattered, and support from the municipality often depends on personal contacts instead of a clear, structured system.

The thesis also shows that Cēsis has taken notable steps to improve its infrastructure and investment climate, such as the creation of Cēsis Industrial Park, the development of creative and technological clusters. However, systemic challenges persist, including a limited land fund, housing availability, and workforce shortages, all of which inhibit business growth.

The conclusions of the research emphasize several key points. First, city marketing must be understood as a strategic governance tool that supports long-term urban development goals, not only as a promotional function. Second, integrating sustainability principles into city marketing can increase a city's attractiveness and competitiveness, particularly when these values are reflected across environmental, social, and economic dimensions. Third, for city marketing to effectively support entrepreneurship, it must actively involve businesses in message creation, use diverse communication platforms, and develop inclusive campaigns that reflect the lived experiences and needs of the local economic ecosystem. Examples from cities like Freiburg and Malmö show that when sustainability and marketing are used together in a smart way, cities can improve their image and attract new people and businesses. Cēsis could benefit from similar ideas by focusing more on business topics and working more closely with local entrepreneurs.

In conclusion, this study contributes to a deeper understanding of how city marketing can act as a bridge between sustainability goals and economic development. The study encourages Cēsis to improve its marketing by focusing more on business and involving the local community, while still promoting the city's culture and beauty.

**Keywords:** city marketing, communication, Cēsis city, sustainability, local entrepreneurship

## **The Tourism Offer in Valmiera Municipality in the Context of the European Green Deal**

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Given that tourism has a significant impact on climate change and environmental degradation – mainly due to carbon emissions, energy consumption and waste generation - it is necessary to critically assess the current tourism development trends and identify opportunities for a shift towards a more environmentally friendly and climate-neutral tourism model. According to Sustainable Travel International (2024), tourism accounts for approximately 8% of global carbon emissions, highlighting the sector's direct contribution to climate change and the associated threats to its sustainability.

The European Green Deal emphasises the transition towards a resource-efficient, competitive and environmentally friendly economy, involving all sectors, including tourism. This strategy imposes new demands on the tourism sector, which must be able to reduce its environmental impact while maintaining economic viability and social benefits for regions where tourism is a significant part of the economy.

To date, no studies have been conducted in the Valmiera municipality on tourism development in the context of the Green Deal and sustainable development. Therefore, the aim of this study is to assess the tourism offer of the Valmiera municipality in line with the principles of the European Green Deal and to develop proposals for a more environmentally friendly and climate-neutral tourism development. Primary data for the study were obtained through in-depth interviews with tourism entrepreneurs and a focus group with specialists from the Valmiera Tourism Board. Secondary data analysis was also carried out, evaluating the tourism offer based on sustainability criteria.

The results showed that some entrepreneurs are already implementing sustainable practices, such as waste management and reducing water or energy consumption. However, activities such as renewable energy use and monitoring of CO<sub>2</sub> emissions are still very limited. The main barrier to the wider adoption of sustainability principles is the lack of finance and resources identified by businesses, as well as the lack of information and support on available initiatives and solutions.

It is important to develop practical, user-friendly guidelines for tourism entrepreneurs on how to implement the principles of the Green Deal in their operations. It also recommends the introduction of a sustainable destination certification system in Valmiera, which could serve both as a quality mark and as a motivational tool for businesses to improve their practices.

**Keywords:** sustainable development, climate change, tourism development, SMS

## **How to Evaluate the Socio-Economic Use of Soviet Military Heritage? Conceptual Approach, Latvia**

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### **Introduction**

Latvia still bears the physical and symbolic imprint of Soviet occupation, particularly in the form of military heritage objects (MHOs) such as bunkers, radar stations, and former army bases. These structures, once built for strategic military purposes, now raise critical questions regarding their role in contemporary society. While some MHOs have been successfully transformed into tourism and education sites, for example, Līgatne bunker, Skrunda radar, many remain unused, abandoned, or controversial due to their ideological legacy and location-specific challenges.

The aim of this research is to explore the socio-economic value of Soviet-era military heritage in Latvia by analysing the perspectives, interests, and involvement of key stakeholder groups. Based on this analysis, VA#MILIT project aims to develop a decision-support model to improve heritage management practices.

### **Materials and Methods**

The methodological approach combines qualitative and quantitative research methods, grounded in stakeholder theory and socio-technical systems analysis. A mixed-methods design includes expert interviews, policy document analysis. Empirical data will be gathered from five pilot sites across Latvia, selected based on criteria such as geographic diversity, object typology, and dissonance level.

A conceptual model using the Event-driven Process Chain (EPC) within the ARIS (Architecture of Integrated Information Systems) framework, method is developed to guide evaluation. It includes 10 stages: site identification, historical and infrastructural assessment, legal and environmental analysis, community engagement, and potential business model development. Quantitative analysis will involve factor and regression analysis to identify the main drivers behind the economic potential of MHOs. A system dynamics model will also be developed using the Stella® Architect software, where various development scenarios will be tested.

### **Discussion**

The initial phase of the study has included an extensive literature review on dissonant heritage, stakeholder involvement, and adaptive reuse, referencing key works (Tunbridge & Ashworth, 1996; Logan & Reeves, 2008; ICOMOS, 2021). Based on this, a conceptual framework has been created, integrating criteria such as symbolic value, physical accessibility, infrastructure condition, and community attitudes. Insights from the OpenHeritage project and international cases in Estonia and Lithuania underline the importance of participatory governance and intersectoral collaboration. Preliminary findings suggest that sites with clear historical narratives, public access, and supportive local policies are more likely to succeed. On the contrary, environmentally degraded or socially controversial MHOs require cautious and inclusive approaches.

A notable finding is the crucial role of public perception: without local trust and inclusion, even well-funded projects risk failure. Therefore, the model emphasizes dialogue, environmental responsibility, and long-term strategic planning involving public and private sectors.

## Conclusions

This research offers a structured and practical tool for assessing and managing Soviet military heritage in Latvia. By combining system thinking, stakeholder engagement, and interdisciplinary analysis, it identifies how formerly burdensome sites may transform into assets for regional development, cultural innovation, and entrepreneurship.

The findings may also hold relevance for other post-Soviet and post-conflict contexts, where heritage carries both trauma and potential. The next steps involve developing a system dynamics model using the Stella® Architect software based on the conceptual model, followed by pilot testing the model in selected sites and validating the results of the simulations, and formulating policy recommendations for national and local governments. The model will allow macro and micro-level decision-makers to distinguish between several management alternatives, thus creating more appropriate conditions for the conservation and use of military heritage for educational and tourism purposes, considering the interests of stakeholders and ensuring the balanced development and well-being of the local population.

## Acknowledgements

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**Keywords:** military heritage, adaptive reuse, socioeconomic potential, conceptual model

## **Place Names of Natural Objects in Rāzna National Park, Their Involvement in Tourism**

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The research explores the place names (toponyms) of natural objects in Rāzna National Park and their potential role in tourism development. This research was initiated by the Nature Conservation Agency's Latgale Regional Administration. The research aims to document and analyze local place names and develop proposals for integration of the natural objects toponyms into tourism offers.

A qualitative methodology was applied, including literature analysis, fieldwork with photo documentation, interviews with residents and experts, and the creation of a digital map of the place names of natural objects. The study was structured in seven chapters, covering the theoretical foundations of toponymy, place name distribution in Rāzna National Park, historical and ongoing name collection campaigns in Latvia, and international examples of using place names in tourism.

The results include a comprehensive toponymic map of Rāzna National Park, identification of over 127 natural object place names (some with multiple language variant), and an analysis of their connections to surnames, folklore, landforms, and former manorial systems. Place names are categorized as lakes, stones, hills and hillforts with their historical and linguistic origins, particularly emphasizing names in the Latgalian dialect. The author proposes three main strategies for involving these place names in tourism: QR code information plaques at natural sites, guided excursions on lakes with boats and kayaks, focused on name origin, and social media campaigns promoting local toponyms, and using digital storytelling to promote lesser-known places.

The conclusion highlights that place names have significant untapped potential for enriching tourism experiences. While the origins of many place names remain uncertain or speculative, additional explanation and interpretation are needed. In many cases the origins of the names are not clearly documented, but they hold intrinsic value in conveying regional identity and can meaningfully enrich visitors' experiences. Place names are a valuable resource for exploring cultural history and for developing tourism products.

**Keywords:** toponyms, Rāzna National Park, Latgalian dialect, Latgale, tourism

# **The 14<sup>th</sup> Student Research Conference**

## **SOCIETY. TECHNOLOGY. SOLUTIONS**

### **Poster Session on 15 October 2025**

## **Communication of the Cold War Military Heritage in Latvia**

**Dace Salnāja**, Vidzeme University of Applied Sciences, Valmiera, Latvia

In Latvia, the military heritage of the Cold War period is an important cultural and historical testimony that combines the Soviet military apparatus, propaganda, and spatial control. However, the communication of this heritage in society is often fragmented and incomplete – it is interpreted both as a threat and as a potential cultural tourism resource. The problem is related to the lack of understanding of how this heritage is interpreted and presented in the media, museums, and public discourse. In a study conducted in 2010, design experts admit that the situation of national identity and existence in Latvia is more complex than in many other countries, with equally deep problems observed only in Israel and Russia (Zelče, 2010). Perhaps parallels can be drawn between the complex and ambiguous perception of military heritage in society and sociological conclusions about a specific situation related to national identity. Qualitative research can provide a deeper understanding of communication practices, public perception, and transformations of the meaning of these objects today.

In Latvia, many of the objects of the Cold War military heritage are still mentioned in both cultural policy and security contexts. However, there is little research that focuses on the communication of these objects - how they are represented, what meanings are assigned to them by different groups of society, and what discourses these objects create in the media space. Similar cases show that military heritage can become a carrier of social identities, memory politics, and even disinformation (Tunbridge & Ashworth, 1996). Therefore, a detailed qualitative analysis is needed in the Latvian context, especially the complex attitude towards the legacy of the Soviet occupation. Criticism of previous studies refers to a too narrow perspective – communication dynamics, participation opportunities, and emotional resonance are not analyzed.

Taking into account geopolitical changes and the intensification of security discourses, the Soviet military heritage is becoming a key element of memory politics and public communication. This topic is also relevant in the context of cultural policy and public unity, especially at a time when symbols of public space and historical narratives are being reviewed.

The preliminary results of the study show that the communication of the Cold War military heritage in Latvia is uneven and often reflects the divided attitude of society towards this historical period. In particular, it will be found that different groups in society perceive these objects differently - some consider them as painful identities of the past, others as a potential resource for cultural tourism education. Interview data could reveal that the role of museums and the media in creating the narrative is essential, but a unified strategy and public participation are lacking. It is expected that the study will highlight the need for open, multilingual, and publicly accessible communication that would allow residents not only to understand this heritage but also to be active in its interpretation and presentation abroad. These conclusions can serve as a basis for the development of new communication strategies that would strengthen Latvia's cultural identity and promote the sustainable use of military heritage for the benefit of society.

The study uses a qualitative research approach, which includes the analysis of multiple data sources to obtain a multifaceted perspective on the communication of the Cold War military heritage in Latvia. Semi-structured interviews with museum staff, media representatives, and local community members were used to collect data to clarify the opinions and experiences of various stakeholders. In addition, media content, museum exhibition materials, policy documents, and visual materials were analyzed to identify key narratives and communication strategies. Such a combined approach allows not only to understand the dominant discourses, but also to reveal nuances that characterize public attitudes and interpretations of the Cold War military heritage.

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**Keywords:** Soviet occupation period, dissonant military heritage, communication



## Young People's Experience of Civic Education and Civic Participation in Family and School

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Civic participation is a consistently relevant topic in democratic societies and serves as a tool for influencing politics and supporting social groups. For some time, significant attention has been given specifically to youth civic participation and the factors that influence it. It is often explored how levels of participation may be influenced by education level, young people's interests, personal motivation, sociodemographic situation, social media, and the availability of participation opportunities. However, little attention has been paid to family habits, family values, civic activity, what is taught in school, extracurricular activities, and the overall school environment.

**The aim of this study** is to explore civic education and civic participation experiences in school and family of young people aged 18–25 in Latvia, in order to understand how these experiences influence their future civic participation. **Research question:** How do young people's experiences of civic education and civic participation in school and family explain their civic participation later in life?

The study involved 202 respondents aged 18 to 25 ( $M=20.83$ ,  $SD=1.92$ ). Of all the respondents, 30.69% were male, 67.33% were female, and 1.98% chose not to disclose their gender. The survey was completed by 3.47% of respondents with primary education, 75.25% with secondary education, and 21.29% with higher education. 40.1% of respondents were from Riga, 30.2% were from a state city (Daugavpils, Jēgļava, Jēkabpils, Jūrmala, Liepāja, Ogre, Rēzekne, Valmiera, Ventspils), 19.3% from another city, and 10.4% from a village or rural area. Data collection was done using a Google Forms survey, focusing on three main topics: civic participation experiences in the family, civic participation experiences in school, and civic participation. Statements about family and school experiences were derived from literature studies, while civic participation was measured using the Civic Participation Scale (Silkāne, Buholcs, Dāvidsone, 2020).

Three factors related to family experience and three factors related to school experience were identified: family's engagement with social and political events, educational conversations about civic education with family, family's participation in civic activities, school curriculum content regarding civic participation, participation opportunities offered by school, involvement in them, and school environment. Internal consistency was observed across all variables (ranging from  $\alpha=0.63$  to  $\alpha=0.86$ ). Regression analysis revealed that when predicting participation in elections, the statistically most significant regression coefficients were age ( $\beta = 0.44^{***}$ ) and the family's engagement with social and political events ( $\beta = 0.18^{**}$ ). When predicting social participation, the most significant coefficients were the family's practical involvement in civic activities ( $\beta = 0.30^{***}$ ) and the family's engagement with social and political events ( $\beta = 0.26^{***}$ ). Social media activism was not predicted by family's practical involvement ( $\beta = 0.08$ ), family's engagement with current events ( $\beta = 0.13$ ), school participation opportunities ( $\beta = 0.12$ ), or civic education content in school ( $\beta = 0.03$ ). When predicting political consumerism, the most statistically significant coefficient was age

( $\beta = 0.25^{***}$ ). In predicting participation in non-governmental organizations (NGOs), the most significant coefficients were age ( $\beta = 0.18^*$ ) and school participation opportunities ( $\beta = 0.26^{**}$ ).

## Conclusions

1. Young people are more likely to participate in elections if their family has followed social and political events and participated in elections themselves.
2. Young people whose families are involved in civic participation activities are more likely to engage in social participation – signing petitions, publicly expressing opinions, discussing issues with others, and staying informed about social and political events.
3. Family and school experiences do not explain social media activism.
4. Political consumerism – purchasing or boycotting products or services from specific producers for ethical or environmental reasons – is more common among older youth whose families have followed social and political events.
5. Older youth with participation experience from school are more likely to be involved in NGOs' activities.

**Keywords:** civic participation, civic education, youth, experience, school, family

## Factors Explaining Conspiracy Mentality

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In today's information environment, where society is faced with a vast amount of information, an increasing number of alternative explanations are emerging — many of which are offered by conspiracy theories. Belief in these theories can have negative consequences, making it important to understand the reasons behind their spread and to promote effective communication that helps reduce this phenomenon. The study of conspiracy mentality and ideas is essential in the field of communication and social sciences, as it can help to understand how to structure communication and develop thinking, targeted communication strategies, promoting media literacy and critical action. Social science researchers have shown great interest in the habits of opinion formation and the quality of the information on which these opinions are based. Special attention has been paid to conspiracy theories, as such theories can undermine various government initiatives. Communication and content can determine whether trust in institutions will be strengthened in society or, more specifically, promote the spread and development of conspiracy theories. Effective communication strategies include not only the transfer of information, but also an understanding of the perception of the target audience and an understanding of various emotional factors. Communication plays a vital role in strengthening public resilience against disinformation and promoting critical thinking; therefore, it is important to understand how to create meaningful, high-quality, and relevant communication. The aim of this bachelor's thesis is to examine the factors that explain conspiracy mentality and to determine the extent to which each factor predicts an individual's tendency to believe in conspiracy theories. To determine the relationship between sociodemographic indicators, level of trust, sense of control, sense of belonging, thinking styles, and conspiracy mentality, as well as to determine the extent to which each of the factors predicts individuals' conspiracy mentality, a quantitative research strategy was chosen, and a survey with a total of 209 respondents was conducted. The data obtained from the survey were analyzed using correlation analysis and regression analysis to assess the relationships between variables. The most significant predictor of conspiracy mentality was low political trust, and an actively open-minded thinking style also played an important role. These results highlight the need to analyse what influences public trust in institutions and how this may contribute to or reduce the spread of conspiracy theories. This study makes a significant contribution to the study of conspiracy mentality in Latvia, emphasizing the significant role of political trust and thinking styles. The results obtained allow for a better understanding of the various mechanisms and factors that promote belief in conspiracy theories. These findings are particularly important in the context of communication science, as the dissemination of conspiracy theories, as well as their acceptance, is largely related to the general circulation of information in society, the role of the media, and various communication channels. In the era of digital and social media, information is consumed quickly and often not evaluated critically, which can contribute to the spread of disinformation and various theories; therefore, media literacy and a critical attitude towards information sources are essential tools to reduce the spread of conspiracy mentality. The results of the study confirm that the types and content of communication can significantly influence public opinions; therefore, it is important to analyze how political, social, and media messages promote or reduce trust in various public or

political institutions. The results confirm that low levels of trust in public institutions can be misused to promote the spread of conspiracy theories in society. This aspect is important in the field of communication, as it indicates the need to create thoughtful, open, trust-promoting communication on the part of institutions, thereby ensuring transparent information flow and strengthening public trust, which will ultimately reduce public susceptibility to conspiracy theories. This issue opens up opportunities for further research, combining psychology and communication sciences, to further understand the acceptance of conspiracy theories and the mechanisms of information dissemination in society. The findings can be used in the development of communication and public information strategies.

**Keywords:** conspiracy mentality, trust, locus of control, thinking styles

## **The Perception of Influencers' Reputation by Latvian Youth – Social Media Users**

**Marta Daniela Kaņepe**, Vidzeme University of Applied Sciences, Valmiera, Latvia

This study aimed to examine how Latvian youth, active users of social media, perceive the reputation of Latvian influencers. In the modern digital landscape, influencers play an increasingly significant role in shaping public opinion and consumer behavior, acting as opinion leaders within their audiences. This influence is also visible in the Latvian context, where influencers are seen as trusted sources of information, entertainment, and lifestyle advice. The growing impact of influencers highlights the need to evaluate their reputations, particularly from the perspective of the audiences they seek to influence.

A total of 200 respondents aged 18 to 35 participated in this study. Data was collected using an online survey, which was based on the Influencer Reputation Evaluation Scale originally developed in South Korea by Rhy & Han (2021) and adapted for the Latvian context. The data analysis was performed using the JASP software, applying descriptive statistics, Cronbach's alpha internal consistency coefficients, frequency analysis of influencer content consumption, T-tests, and correlation analysis.

The findings revealed high internal consistency for all dimensions of influencer reputation, namely communication skills ( $\alpha = 0.90$ ), influence ( $\alpha = 0.88$ ), authenticity ( $\alpha = 0.81$ ), and expertise ( $\alpha = 0.88$ ). Overall, respondents evaluated influencer reputation positively, with authenticity emerging as the most highly valued dimension. Statistically significant gender differences were observed in the evaluations – male respondents tended to rate influencer reputation higher than female respondents. In addition, a positive correlation was identified between influencer content consumption frequency and all dimensions of reputation, as well as between respondents' age, education level, and perceived influencer reputation.

These results suggest that Latvian youth approach the evaluation of an influencer's reputation in a multifaceted and critical manner, considering not only the influencer's ability to communicate or appear knowledgeable but also their authenticity and ethical behavior. Authenticity, in particular, was identified as a crucial component in building trust with followers and sustaining long-term influence. Ethical concerns were also highlighted, as influencers sometimes promote products they do not use themselves, thus misleading followers for commercial gain. This underscores the necessity for influencers to maintain transparency and credibility to preserve their reputations.

The results of this study have practical implications for influencer marketing strategies in Latvia. For influencers, the findings emphasize the importance of aligning content with personal values, acting ethically, and maintaining genuine relationships with their audiences. For organizations and marketers, the results offer guidance on selecting collaboration partners who resonate with the values and expectations of target audiences, especially among younger demographics.

Understanding how reputation is perceived helps both parties foster trust, improve engagement, and ensure the effectiveness of influencer-driven campaigns.

In conclusion, the study contributes to a deeper understanding of influencer reputation in the Latvian context and highlights the significance of authenticity as a key factor for success in digital communication. As the field of influencer marketing continues to evolve, reputation management remains an essential aspect of sustainable growth and audience trust.

**Keywords:** influencer reputation, social media, authenticity, youth, Latvia

## Personal Branding on Social Media: Athletes' Experiences on the Instagram Platform

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**The significance of the topic** lies in the growing global trend of personal branding on social media in recent years. For athletes, personal branding plays a crucial role in strengthening relationships with fans, attracting sponsors, and expanding opportunities beyond their athletic careers. Although personal branding among athletes and related concepts have been widely researched globally, studies on this topic in Latvia remain limited. Last year, the author explored the experiences and perspectives of young athletes (aged 16–22) regarding personal branding on social media. The findings revealed that personal branding is not the primary purpose for which young athletes use social media, and their knowledge of the topic is insufficient. This led to the decision to investigate the experiences of more seasoned athletes to determine whether their approaches and understanding differ.

**Purpose of the research and questions:** The purpose of this research is to explore how athletes develop their personal brand and communicate with the public on the Instagram platform. The research addresses the following questions:

1. What are athletes' experiences in building personal brands on Instagram?
2. What types of content do athletes publish on their Instagram profiles?
3. What are the enabling and hindering factors in the personal branding process on Instagram?

**Methodology:** A purposive sampling strategy was employed based on the Instagram profiles of Latvian athletes. As a result, eight professional athletes from various sports, who actively create content on Instagram and agreed to participate, were selected. The gender distribution was equal, with four women and four men. Data collection involved semi-structured interviews with the athletes and content analysis of their Instagram posts from the past year. Interview transcripts were analyzed using thematic analysis, and Instagram content data was categorized. Participant anonymity was ensured throughout the research process.

**Main results:** The participating athletes recognize the significance of personal branding, describing it as an essential part of a professional sports career. Their experiences reveal that personal brands tend to develop organically alongside professional achievements and recognition but are later consciously shaped to reflect personality traits, values, and interests. The most important elements of a personal brand are the athlete's image and values, both of which are communicated in real life and on social media. An athlete's personal brand extends beyond athletic performance — it also encompasses aspects of everyday life, hobbies, and civic engagement.

One of the key factors in successful personal branding on Instagram is the regular publication of high-quality content. Collaborations with other brands are also significant, often serving as

motivation for athletes to focus more on developing their Instagram presence. While most athletes in the study do not plan their content systematically, some emphasize the benefits of doing so. Challenges in building a personal brand on Instagram include exposure to negativity from other users and a lack of time due to demanding training and competition schedules.

Athletes feel a strong sense of responsibility for the content they share, particularly considering the children and young people who follow them. They highlight a desire to inspire younger generations to engage in sports by promoting a positive image and a healthy lifestyle.

The Instagram content analysis showed that humorous and educational posts, as well as competition-related content — especially involving the Olympic Games — generated the highest engagement. Values most frequently emphasized in athletes' Instagram content include teamwork, a positive attitude, family, and hard work.

**Conclusions:** Personal branding is a key component of a professional athlete's career. Instagram is an effective platform through which athletes can share their athletic lifestyle, achievements, personality, and values. Regular, high-quality content is essential for developing a strong personal brand, although this process may be hindered by limited time and exposure to negative feedback. The most valuable content is that which builds emotional connection with followers, motivates, and inspires. A notable difference in understanding of the personal branding concept exists between young and professional athletes. Future research should explore the perspectives of athletes' followers to determine which types of content are most appealing to audiences. Based on the findings of this study, it is recommended that mentoring programs and educational initiatives be developed, with support from sports organizations, to enable young athletes to learn from the experiences of professionals.

**Keywords:** athlete personal branding, Instagram, social media, content creation



## **Artificial Intelligence in Teachers' Pedagogical Practice**

**Leticija Laura Mote**, Vidzeme University of Applied Sciences

The integration of artificial intelligence in education has become a pressing issue worldwide. With the increasing availability of AI tools, teachers are faced with the challenge of not only understanding these technologies but also meaningfully incorporating them into their pedagogical practices. The successful implementation of AI in the learning process can significantly improve lesson planning, personalized feedback, and the overall efficiency of teaching. However, its use depends not only on technological availability but also on individual and environmental factors such as teachers' competencies, attitude, and institutional support. This research addresses a critical knowledge gap in the Latvian educational context by investigating which factors encourage or hinder teachers' use of AI in their professional activities. The primary aim of the study was to examine what individual and environmental factors influence the use of artificial intelligence in teachers' pedagogical practice. Specifically, the research focused on three core components: teachers' AI competence, their attitudes toward AI, and their actual usage of AI tools during teaching. The study also explored how demographic indicators such as age, gender, and education level relate to these variables. The study used a quantitative research approach. A structured questionnaire was distributed to a sample of secondary and high school teachers in Latvia. The instrument was designed to measure three main constructs – AI competence, attitude, and behavior using Likert scale. Correlation and regression analyses were conducted to explore the relationships between variables and determine the most significant predictors of teachers' AI-related behavior. The results revealed statistically significant positive correlations between all three main variables: teachers' competence, attitude, and behavior. This indicates that these aspects mutually reinforce each other – greater AI competence contributes to a more positive attitude, which in turn encourages more active use of AI in teaching. Regression analysis showed that competence and attitude were the strongest predictors of behavior. Teachers who feel knowledgeable and hold favorable views about AI are more likely to integrate it into their practice. Demographic factors such as gender, age, and education level were not statistically significant predictors of AI usage. Interestingly, specific teaching activities revealed differences in AI use. Teachers reported more frequent use of AI for lesson planning and generating teaching materials. In contrast, lower behavioral ratings were observed in tasks such as using AI for student assessment or providing feedback. This suggests a cautious approach in areas where ethical concerns and responsibility are more prominent. These findings align with existing literature, which highlights the importance of both technical and ethical literacy when applying AI in education. Another key finding was the negative correlation between age and AI-related behavior, attitude, and competence. Younger teachers were generally more open to using AI, while older educators tended to assess their skills lower. However, this does not suggest incapability but rather underscores the importance of supportive school environments. Organizational support, including training, time for experimentation, and access to technological resources, was emphasized as a crucial factor in reducing uncertainty and enhancing AI integration. The study confirmed that teachers' use of artificial intelligence is significantly influenced by their AI competence and attitudes, rather than demographic characteristics. While most teachers recognize the potential of AI in education, actual

usage remains uneven, particularly in complex or ethically sensitive areas. Positive attitude and competences alone are not sufficient –systematic support from school leadership and clear implementation guidelines are needed to promote confident and responsible use of AI in classrooms. The results underscore the need for targeted professional development, especially for older teachers, to foster equity in access to innovation. This research provides a valuable basis for future school strategies and educational policy planning to ensure the effective and ethical integration of AI into teaching practices.

**Keywords:** artificial intelligence, teacher's pedagogical practice, attitude, competence, behaviour

## **USB Port Access Control Software With User Authentication for Windows Operating Systems**

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Nowadays, any user or company that uses USB-type sockets on a daily basis without taking appropriate security measures can be exposed to significant computer security risks. In order to be able to reduce such risks, it is important to restrict such access by unauthorized users or unknown devices by using specific USB socket control tools that prevent USB sockets from being operated without the approval of authorized users.

The aim of the bachelor's thesis is to develop USB socket control software with user authentication for Windows operating systems, which will prevent unauthorised operations on USB sockets. In order to achieve the specific objective, a literature analysis was carried out, alternative solutions were investigated, and the design, architecture, functionality, and user interface of the software were then developed. A prototype of the software was created and tested on different Windows operating systems. The result of the project can be used to disable USB sockets on devices and grant access only to authorised users and devices.

**Keywords:** USB, cybersecurity, data, software

## Encrypted Web File Storage With Cloud Integration

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Cloud storage services have become an integral part of our daily lives, offering an effortless way to store and keep a historical version of our data in case of data loss. These services make it easy to share stored data while controlling access to them. However, using cloud storage services raises significant security and privacy concerns, especially during data leak incidents or cases when accounts become compromised due to hacking activity.

Major technology companies, such as Microsoft and Google, offer built-in encryption in their OneDrive and Google Drive services, but these features do not always provide full control over the security and privacy of the stored data. In addition, cloud storage services are based on closed-source software. This limits the ability to check how the cloud-stored data is processed in these services, as well as limits the ability to check for vulnerabilities. While companies advertise full privacy, due to the closed-source software, the possibility of company-side encryption key retention may lead to unknown data access without the user's knowledge. With the rise of artificial intelligence, the risk that user data is utilized to train such systems or used for other purposes is high. In addition, deleting one's data in cloud storage may result in the data being retained on an offsite system or even in back up copies, which raises more security and privacy risks about how the uploaded data is stored and processed.

Open-source market solutions, such as VeraCrypt and Cryptomator, allow users to encrypt their files before they are uploaded to the cloud storage, but users may find these tools difficult to use or to set up. This is particularly true in organizational environments, where the systems infrastructure may require administration rights to launch or install external software, which may limit the possibilities where such solutions can be utilized.

To increase users' privacy and security while utilizing popular cloud storage solutions, the author has created a web-based solution, allowing users to create encrypted file storage vaults with their favorite cloud storage services. The given solution encrypts uploaded data on the client side before it is ever sent to the cloud storage provider. To do this, the author researched the most popular based encryption algorithms, researched the given solutions available on the market and their functionality. To understand users' expectations from such a solution, a cloud storage user-based survey was conducted. Additionally, research on global and European-based data protection regulations and standards, as well as research on the most common causes of user vulnerabilities that lead to cloud storage data leaks, was conducted during the creation of the solution.

The author-created solution allows users to keep full control over their data security and privacy through a simple password encryption system, while allowing users to manage the encrypted data themselves. With an author custom two factor authentication encryption function, which requires both server and client-side authentication, even in case of a data breach, users can keep their privacy and security. The solution is created for all cloud storage users, with the intention to provide

ease of use for regular everyday users by allowing connection to cloud storage services such as Dropbox, while also allowing advanced cloud storage connection for users with higher IT experience, utilizing SFTP and FTP connections. Due to users having full control over the encryption parameters, users are free to move the previously created file vaults to different cloud storage providers at any point, making the given solution portable.

While the main author's intention of the project to increase users' data security and privacy was reached, further development into other cloud storage support, such as WebDVA and Google Drive, is yet to be implemented into the solution. Added security such as HMAC support to prevent unauthorized data manipulation, as well as FIDO2 authentication for easier and safer web-based authentication.

**Keywords:** privacy, security, cloud storage, encryption, web-based solution

## Integrating Software Supply Chain Security into CI/CD Pipeline

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Software supply chain security is one of the fastest-growing areas in the IT industry. This is partly because there has been a big jump in attacks related to supply chains, with the number of these attacks doubling in 2023 compared to earlier years (Statista, 2024). Modern applications have complex structures and rely heavily on third-party dependencies and external services, which makes them vulnerable to potential threats and attacks. Many companies already use CI/CD pipelines to automate software development, deployment, and testing. However, adding strong security measures to these pipelines is still challenging. There are many tools and standards available to improve software supply chain security. Nevertheless, their adoption and usage are not widespread, as many developers prioritize speed over security. This work is aimed at software developers, DevOps engineers, and security teams seeking simplified ways to integrate security measures without disrupting workflows.

**The problem** is that even though more people realize the risks in supply chains, many organizations still find it hard to put reasonable security practices into their daily work. There are so many tools out there, and new ones keep coming out, each trying to solve a particular problem. But these tools don't always work well together. This causes another problem: both the market and companies often don't have the right skills or enough time to use these tools in the best way. Also, there isn't a single, agreed-upon way to ensure security practices work well across different CI/CD platforms. Because of these issues, software development processes are still at risk from supply chain attacks, which can harm the quality and integrity of the software and user trust.

This work **aims** to investigate and assess the most effective methods for securing the software supply chain, focusing on industry standards. Additionally, it seeks to create a fully integrated, automated CI/CD pipeline that includes chosen security tools and practices.

Tasks are:

1. Explore and evaluate best practices
  - Analyze common vulnerabilities and attacks in software supply chains.
  - Research industry standards such as SLSA, OWASP, etc.
  - Identify widely used tools that align with best practices.
  - Document the criteria used to select tools and justify their inclusion.
1. Develop an integrated pipeline
  - Design a prototype CI/CD pipeline integrating tools
  - Automate security checks using tools.
  - Test the pipeline with sample applications to validate effectiveness.

**The main methods** will include a literature review, tool evaluation, prototyping, configuring, and testing.

The study integrates open-source tools, including GitHub Actions, Cosign, Trivy, CodeQL, Codefresh GitOps Cloud, and others, to enforce best practices across all CI/CD components. The pipeline includes mechanisms for commit verification, artifact signing, SBOM and SLSA provenance generation, sift-left security testing, and GitOps-based deployment.

Through this work, a prototype was developed that enables secure, reproducible builds. The implementation demonstrates that software supply chain security can be achieved using open-source tools.

This thesis contributes a practical and replicable model for integrating supply chain security into DevOps workflows. It is relevant to academia, startups, and enterprise teams seeking to adopt a modern DevSecOps approach.

**Keywords:** supply chain, CI/CD, SBOM, SLSA, Sigstore, DevSecOps

## **Integration of Artificial Intelligence (AI) Solutions With Traditional Cybersecurity Audit Methods**

**Aleksis Kālis**, Vidzeme University of Applied Sciences, Valmiera, Latvia

The integration of artificial intelligence with traditional cybersecurity audit methods in shopping centers represents a significant advancement in addressing contemporary security challenges. During the research process, the author observed that conventional security assessments often fail to identify numerous vulnerabilities due to their time-consuming nature and limited capability to detect sophisticated threats targeting both physical and digital infrastructure. This observation prompted the development of an innovative solution that enhances traditional auditing through AI-powered analysis.

The methodology employed a mixed-methods approach that proved quite effective for the research objectives. The author utilized a WiFi Pineapple Mark VII device to passively scan wireless networks around a shopping center in Riga. This specialized hardware collected data without leaving digital footprints - a crucial aspect for obtaining authentic results in security research. The study compared two analytical approaches: the traditional manual analysis and an automated approach developed by the author that integrated the n8n automation platform with OpenAI models. While the manual method examined data from 87 access points collected from a strategically selected location, the AI-enhanced solution performed automated analysis with remarkable pattern recognition capabilities that were not immediately apparent through manual inspection.

The findings demonstrated significant efficiency improvements with the AI-integrated approach. The automated system reduced audit time from 3.5 hours to just 10 minutes - a 21-time improvement in threat identification speed. Through the automated systematic analysis of the scan data, the author identified 87 access points with security vulnerabilities across the shopping center environment. The security risk assessment revealed three distinct categories: high risk (15 networks, 17.2% operating without encryption), medium risk (22 access points, 25.3% with exploitable WPS enabled), and low risk (31 access points, 35.6% employing hidden SSIDs that provide minimal actual security).

Channel distribution analysis showed strategic concentrations on non-overlapping channels 1, 6, and 11, accounting for 70.1% of all access points, which suggests deliberate network planning but also indicates potential congestion vulnerabilities. The average signal strength across all detected access points was -74.8 dBm, indicating that many networks were operating at the edge of their effective range.

The AI-integrated solution enhanced detection accuracy by identifying complex attack patterns through automated correlation of multiple security parameters. This capability proved particularly valuable for detecting sophisticated threats that conventional manual analysis would miss due to data volume limitations and analyst fatigue. These findings confirm the substantial advantages of integrating artificial intelligence with traditional cybersecurity audit methods, particularly in complex commercial environments requiring rapid, comprehensive security assessment.

Based on the comprehensive analysis, the author concludes that integrating AI with traditional cybersecurity audit methods substantially improves security assessment effectiveness, particularly



in complex commercial environments like those found throughout Latvia. The developed system demonstrates practical value through its ability to perform cyclical monitoring and communicate security issues in an accessible manner for IT specialists without advanced cybersecurity expertise. This hybrid approach shows particular promise for organizations with complex wireless infrastructures, such as regional shopping centers or educational institutions like Vidzeme University of Applied Sciences, where balancing robust security with practical implementation remains an ongoing challenge.

**Keywords:** artificial intelligence, cybersecurity audit, WiFi security, n8n automation

## Human Vision Evaluation With Multifocal Stereoscopic Augmented Reality Glasses

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**Significance of the topic:** Nowadays, innovative solutions improve the quality of human health diagnostics. The optometry industry also continues to develop, actively integrating the latest technologies. Augmented reality (AR) glasses are directly related to optometry and the human visual system. Currently, there is a lack of research on whether it would be possible to replace or supplement classic visual acuity tests using multifocal stereoscopic AR glasses.

**The purpose of the research** was to develop and analyze technology for assessing the quality of human visual acuity using multifocal stereoscopic AR glasses. To achieve this goal the following tasks were determined: research of theoretical materials, creation of a theoretical model, development of an augmented reality visual acuity assessment solution, analysis of the obtained data and drawing conclusions about the usefulness of the solution.

**Methodology:** The study analyzed the current situation in optometry and the human vision testing system, evaluated technical limitations and potential benefits from the use of AR glasses to develop a system for testing human visual acuity. The system was created in collaboration with researchers from the Department of Optometry and Vision Science of the University of Latvia and the company Lightspace Technologies. To test the system, 17 participants were enlisted, of which 11 participated in the system re-test. Participants had varying levels of visual acuity. They performed the test at all three distances – 50cm, 100cm and 200cm. The users' task was to determine in which direction the Landolt ring is oriented, gradually decreasing or increasing depending on the user's inputs. The system is designed to display the Landolt ring with correct focus indications. All test results were saved in .csv format file to later analyze them. Data processing was done with IBM SPSS Statistics 29.0.v. Test-retest reliability was determined using interclass correlation coefficient (ICC).

**Main results:** A system was developed for diagnosing human visual acuity using multifocal AR glasses. The developed program is adaptable to the individual needs of each person, and also saves the results obtained. The developed program correctly identified people who do not use vision aids on a daily basis, achieving a result of  $\text{LogMAR} < 0.5$ , while people who use vision aids on a daily basis achieved a result of  $\text{LogMAR} > 0.5$ . At 50cm distance the system shows average test-retest reliability (ICC = 0.724), at 100cm excellent test-retest reliability (ICC = 0.926), as well as at 200cm (ICC = 0.907). The overall ICC is 0.801, which indicates good test-retest reliability, meaning that participants repeatedly obtain the same or similar results. The results obtained are statistically significant ( $p < 0.05$ ).

**Conclusion:** The developed system shows good test-retest reliability, which indicates that participants receive equivalent results on different occasions. The project has the potential to be used in other human visual acuity studies, as the results obtained show that the minimum LogMAR value is achieved to determine whether people need vision correction aids. This visual acuity test

should be performed together with the classic Landolt ring vision test to compare the results obtained by users in both tests. This would allow for better validation of the developed system and a more complete understanding of its effectiveness.

**Keywords:** multifocal AR technology, human vision and perception system, augmented reality, AR glasses, Landolt ring, Landolt test

## **Development of Geospatial Data Time Series Visualization Tool**

**Ralfs Laipiņš**, Vidzeme University of Applied Sciences, Valmiera, Latvia

Sensor usage in crop production is gaining increased popularity to support agricultural decision-making based on readings from soil data. The Finnish sensor manufacturing company "Soil Scouts Oy" needs to identify the most suitable locations within a field for sensor placement. Their current approach does not consider changes in soil properties over multiple years. To ensure that at least one sensor is placed in each distinct field area based on soil properties, it is necessary to analyze geospatial data in time series during multiple vegetation periods over several years. The aim of this work is to develop a geospatial data time series visualization tool, integrated with spatial data processing prototype developed by SIA "SunGIS". The tool will enable Soil Scouts Oy specialists to identify distinct areas within fields and determine the best locations for sensor deployment. To achieve this goal, theoretical research was conducted, suitable technologies were selected, a mock-up design was created, a tool was developed, and integrated with the SunGIS prototype. The outcome of the work is a fully functional tool that meets Soil Scout Oy's previously defined requirements. A functional geospatial data visualization tool has been developed and successfully integrated with data processing prototype created by SunGIS. Functionality-wise, it fully meets the requirements defined by Soil Scouts Oy. Chosen technological solutions were fully sufficient for the development of the geospatial visualization tool. While the tool and its functionality have been comprehensively tested, its overall user experience still needs to be tested by Soil Scouts Oy specialists. The tool was developed by using modular components with future scalability in mind. In the future, if Soil Scouts Oy wishes to add additional features, they can negotiate further development with SunGIS.

**Keywords:** integration with prototype, geospatial data, visualization on map

## Smart Sock Technology: Integrating Biofeedback System for Enhanced User Experience

**Lydia Kamynina** and Andis Biksāns, Vidzeme University of Applied Sciences, Valmiera, Latvia

The aim of the project is to provide interactive training by combining smart textile technology, mixed reality (MR), and a software program to deliver adaptive and user-specific feedback during exercises. In the course of the project, the biofeedback-based injury prevention program enhancing the effectiveness of the FIFA11+ training program in Latvian youth football was developed and evaluated. The problem is that normally the quality and correctness of exercises are monitored by trainers in a group setting. It makes it difficult to provide individual feedback, allowing for incorrect movement to persist. Such injury preventive programs like FIFA11+ require precise movements to result in intended benefits. Therefore, there exists a need for an objective individual solution that would provide real-time feedback.

The DAid® smart sock system uses pressure sensors integrated into each sock's sole. These sensors capture raw plantar pressure data, which is streamed to a computer-based developed application using a Bluetooth connection, interacting with a Client-Server model. Upon connection, the devices are calibrated to determine personalized pressure thresholds and use the offsets for Center of Pressure (CoP) calculations, ensuring individual sensor variations and user-specific biofeedback. The calibrated pressure data is filtered in real time and used to calculate the CoP coordinates based on their positions for each of the sensors. The CoP is mapped to 2D coordinates and evaluated against predefined red and green feedback zones for each separate phase of the exercises.

The system is built as a .NET-based client-server architecture. The server part handles connection with DAid® smart socks via COM ports, handles data receipt and its processing. Sensor data is collected from 4 pressure points from each sock, next it's calibrated, filtered, and normalized in real-time. The client-side managed exercise execution, connection with the Graphical User Interface (GUI), Head Mounted Display (HMD), and the server part. It receives the calculated CoP coordinates from the server part and, based on exercise logic, provides zone-based feedback. Each exercise includes phase-based logic, zone boundaries, and timing. Sensor data is filtered using a moving average and offset-calibrated based on pressure distribution. CoP is calculated per foot and compared to predefined "green" and "red" zones. If the user moves outside the correct zone for too long, feedback is triggered. Once the trainer starts the exercise routine via the GUI, the mentioned before functionality of the Center of Pressure (CoP) Calculations are transmitted to the HMD application via TCP connection, allowing the user to see a visual informational aspect of the incorrect pressure placement of the foot. UI inside the HMD for the pressure feedback is split into 4 sections: sole, toes, lateral, and medial. The sensor that registers as having an increased pressure will show as red, with the addition of directional arrows, signaling a correct instruction on how to redistribute the pressure on the foot properly, whilst following the FIFA11+ programs selected exercises execution with the provided avatar animation, as well as audio and visual textual instructions.

The evaluation of the program is done in multiple stages. For future analysis, the received raw sensor data is saved in separate files for each user and test sessions. Surveys are created for both football

players and trainers, to gather data based on the project's criteria – Efficiency, Emotional aspects, as well as Accessibility. Allowing the project to evolve to a more refined final product, as well as monitoring the players, detecting any changes in their patterns to justify any abnormalities in their results.

The project offers practical, interactive, and scalable solutions for injury prevention in youth football. It offers real-time monitoring, provides visual and audio feedback by improving biomechanical awareness, and a personalized training experience, mixing the real world with gamified elements of the application.

**Keywords:** biomechanics, virtual reality, football, smart textiles, injury prevention

## **Texture Generation Program 'TexGen' Prototype Development**

**Gints Kristaps Pērkons**, Vidzeme University of Applied Sciences, Valmiera, Latvia

The aim of the work is to create a prototype of the generation “TexGen” program. To achieve this, several tasks were set: to study existing texture generation methods, to develop a TexGen prototype, and to test its functionality and efficiency. At the end of the work, a functional "TexGen" prototype has been developed, which provides the opportunity to create various customizable structures using various network elements to describe their creation. Textures can then be used in the development of computer games, as well as in architectural and design visualizations.

**Keywords:** texture, procedural, graphics, games, visualization, node-based, generation, prototype

## **Development of a Rogue-Like Game With Procedurally Generated Content**

**Kristiāns Žondaks**, Vidzeme University of Applied Sciences, Valmiera, Latvia

Procedural content generation is increasingly used in game development and is one of the key features of rogue-like games. The aim of this work is to develop a working prototype of procedurally generated game zones and opponent placements using methods that meet the requirements of the rogue-like genre.

To achieve this goal, an analysis of the game engines was carried out to determine the most suitable solution for the project. Different procedural generation methods were studied in depth, and the most appropriate one for the rogue-like genre was selected. A game was developed on the selected engine and then tested with computer game players by conducting surveys on the quality of the game.

The result is a rogue-like game with procedurally generated play areas and opponent placement. During the development process, the author has significantly increased their knowledge in the field of procedural generation, and the game has the potential to be published on Steam after further improvements.

**Keywords:** procedural generation, game development, level design



## Development of a Mental Math App for Education Technology Matmat

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Pedagogical approaches employed in the instruction of mathematics to children, particularly within the primary school curriculum, frequently encompass conventional instructional methodologies that prioritize desk work, written assignments, and formal tasks. This unilateral strategy is inadequate for inspiring motivation in all children, particularly those grappling with concentration challenges. Digital and physical movement solutions, including interactive pads, smart tables, and motion sensors, have the potential to serve as a conduit between a child's innate need to move and the learning task at hand. The utilization of motion-based technologies has been demonstrated to facilitate a more profound comprehension of mathematical concepts, while concomitantly enhancing factors such as attention span, memory, and motivation. These exercises have been shown to be particularly efficacious for head calculation, a task that demands both a brief yet concentrated focus of attention and a sequence of actions. The aim of the bachelor's thesis was to develop a prototype mobile app that enables children aged 3-13 to practise their mental math using a movement-based approach. The app is part of an innovative educational technology called Matmat, in which mental math problems are solved using a Bluetooth-connected multimodal pressure-sensitive sensor floor pad. This technology helps to combine digital learning with physical activity, making it particularly suitable for children with attention disorders or special needs. The theoretical underpinning of the work is based on research demonstrating the effectiveness of movement and multisensory learning, particularly in STEM fields. The aim of the work was to develop a child-friendly app that: 1) provides personalised and adaptive math tasks; 2) connects to an external sensing device; 3) stores and analyses user results; 4) provides immediate visual feedback; 5) offers a visually simple and intuitive user interface. The main methods used were: user needs analysis, comparison of similar applications, system analysis, software development with Flutter/Dart, database integration with Firebase, and functional testing. The result was a working prototype that successfully connects to the sensor pad, records user responses, and demonstrates potential for practical use in a learning environment. The work demonstrates that a motion-based, child-friendly app can serve as an effective learning tool for developing mathematical skills and enhancing motivation.

**Keywords:** mental-math, Bluetooth, Matmat, Flutter, child-friendly, education technology, gamification

## Development of an Interactive Light Installation Application for Wish Processing and Visualisation Using AI

**Natālija Andersone**, Vidzeme University of Applied Sciences, Valmiera, Latvia

This thesis explores the integration of artificial intelligence (AI) into small-scale digital art projects, focusing on the real-time processing and interpretation of language-based user input. The research centers on the development of an interactive software application for the cultural installation “*Gaismas namiņš*”, unveiled in early 2025 in Cēsis, during its year as the cultural capital of Latvia. The installation invites public participation by allowing visitors to submit written wishes, which are then semantically analyzed by a language model and transformed into personalized lighting sequences.

The primary aim of this project was to create a responsive light installation system capable of analyzing, evaluating, and visualizing natural language input using AI techniques - specifically, generative large language models (LLMs). The system was intended for public use in cultural events, demanding robustness, ease of use, and a high degree of interpretive nuance. To achieve this, the project followed a structured development process, beginning with the definition of functional and non-functional requirements. The software architecture was designed to support modularity and future scalability, ensuring maintainability beyond the initial installation period.

A key part of the research was the investigation into natural language processing (NLP) in the Latvian language, where data availability and model performance are limited compared to more widely spoken languages. Given these constraints, the decision was made to utilize OpenAI’s API for text analysis. The integration of a commercially available LLM allowed for reliable and context-aware semantic evaluation, enabling the system to rate user-submitted wishes on a scale from 1 to 10 based on sentiment, creativity, and language richness. These ratings were then used to trigger one of several preconfigured lighting scenarios, creating a responsive and emotionally engaging experience.

Methodologically, the project combined a literature review of AI use in digital and interactive art, comparative analysis of similar international projects, and practical implementation through software engineering. The software was developed using Unity for the front-end interface and OpenAI’s API for back-end analysis. Data was stored locally using SQLite and backed up daily via a Python-based process that automatically uploaded CSV files to Google Drive. Additional technologies included loopMIDI for sending real-time commands to the lighting system and Task Scheduler for automating background operations. The prompt engineering process—an essential component of working with LLMs—was refined iteratively through empirical testing using the OpenAI Playground.

The final outcome was a fully functional, real-time interactive system capable of capturing, interpreting, and responding to user input in a meaningful and artistic manner. Over the course of

the exhibition, the system performed reliably, and visitor feedback indicated high engagement levels and emotional resonance with the installation. The project thus demonstrates the potential of integrating LLMs into public digital artworks, especially in the Latvian cultural context, where technological solutions in the creative sector are still emerging.

Among the key conclusions is that off-the-shelf AI tools such as OpenAI's API can be effectively adapted for Latvian-language input when paired with well-designed prompts and user interfaces. The research also highlights the importance of backup systems, local data storage, and simple but robust UI design in public-facing installations. While Unity was chosen for its flexibility and real-time rendering capabilities, alternative frameworks for future development—such as WPF, web-based platforms, or lighter 2D engines like Godot—are also discussed.

Ultimately, this thesis contributes to the growing field of AI-enhanced interaction design, offering a practical example of how large language models can be used to foster emotional, linguistic, and cultural connections in digitally mediated public spaces.

**Keywords:** natural language processing, prompt engineering, Artificial Intelligence, prompt

## **Development of a Smart Greenhouse Control System Using the ESP32 Microcontroller**

**Kristaps Ciguzis**, Vidzeme university of Applied Sciences, Valmiera, Latvia

Paying attention to recent tendencies, there has been a noticeable increase in the number of individuals interested in growing plants themselves. With advancements in technology and the increased availability of automation tools, it has become possible for anyone to equip their private greenhouse with an autonomous system for plant irrigation, monitoring, and maintenance, thereby reducing the need for manual care. Through this thesis, the author aims to deepen their knowledge and apply it to the development of a prototype for a smart greenhouse control system. Maintaining a greenhouse is a time-consuming and manual chore, and insufficient attention to plants can result in reduced yields or, in the worst case, complete loss of crops. The goal of the thesis is to create a system that reduces the workload of the modern gardener by developing a prototype of a control system that enables automation and monitoring of plant growing processes. During the thesis project, a web application and microcontroller code were developed to allow both systems to work together.

**Keywords:** IoT, API, ESP32, sensors, microcontrollers

## Experimental and Numerical Study of a Gas-Water Heat Exchanger for Industrial Waste Heat Recovery

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Industrial processes often release large amounts of thermal energy in the form of exhaust gases, which, if not recovered, contribute to energy waste and environmental pollution. This study aims to address this issue by presenting the design, fabrication, and performance evaluation of a low-cost, sustainable gas-to-water heat exchanger system specifically tailored for industrial waste heat recovery applications. The objective is to enhance energy efficiency and reduce environmental impact in industrial facilities. The system consists of two core components: a custom-designed combustor and a heat exchanger fabricated from recycled automotive radiators. The combustor serves as a controlled source of exhaust gases, with its design based on critical combustion parameters including the air-to-fuel (A/F) ratio, flame length, swirl intensity (swirl number), dilution air mass flow rate, and the thermal resilience of the materials used. The inclusion of swirl enhances the mixing of air and fuel, stabilizing the flame and ensuring a uniform temperature profile within the exhaust gases, while flame length control ensures that combustion is completed within the designed chamber volume, improving heat transfer potential and system safety. The combustor casing and internal components were fabricated using heat-resistant materials capable of withstanding high temperatures, ensuring durability and sustained performance. A dilution air system was incorporated to allow real-time adjustment of the exhaust temperature, thereby mimicking variable industrial conditions and enabling detailed study of the exchanger's thermal response under different thermal loads. The gas-to-water heat exchanger was fabricated using scrap automotive radiators sourced in various dimensions. A selection process was conducted to determine the most efficient configuration in terms of surface area, flow rate compatibility, and ease of integration. The exhaust flow path from the combustor to the exchanger was custom-designed to optimize heat transfer while minimizing pressure losses, including the evaluation of radiator positioning and the use of connecting ducts to maintain a steady, turbulent flow for improved thermal contact. A centrifugal water pump was selected and matched with the system's specifications to maintain consistent flow rates across varying thermal conditions. To enhance system monitoring and data acquisition, several sensors were integrated. Thermocouples were positioned on both the gas and water sides to measure inlet and outlet temperatures, and a flow meter was installed to monitor the water flow rate. All sensors were interfaced with an Arduino microcontroller, allowing real-time data logging and system diagnostics. This approach enabled the collection of accurate and synchronized datasets for both experimental analysis and the validation of numerical models. Experimental results were supported by numerical simulations conducted in MATLAB/Simulink, enabling deeper analysis under various operating scenarios. The models incorporated principles from the first and second laws of thermodynamics to identify and validate optimal heat recovery conditions. Key performance metrics such as the overall heat transfer coefficient, effectiveness, heat transfer rate, and the Number of Transfer Units (NTU) were calculated and compared with experimental data to

validate system performance. The results revealed a remarkable heat exchanger effectiveness of 87.6% at an exhaust gas temperature of 431 °C and a gas mass flow rate of 0.2 kg/s. The water-side temperature increased by 36.3 °C, indicating efficient thermal energy transfer from the exhaust to the water. These findings confirm the system's potential for application in industrial environments where energy recovery and sustainability are operational priorities. Furthermore, the system's economic viability was evaluated through the calculation of the Levelized Cost of Energy (LCOE), which was found to be as low as 0.0007 USD/kWh. This exceptionally low value is attributed to the use of recycled materials and minimized capital expenditure. In conclusion, this study focused on the practical development and evaluation of a gas-to water heat exchanger system to experimentally study the concept of waste heat recovery. The system was designed using low-cost recycled components and tested under controlled exhaust gas conditions. Its thermal behavior was analyzed across a range of operating scenarios, and the experimental data validated the numerical model, showing consistent performance patterns. Moreover, the use of recycled materials not only minimized fabrication costs but also contributed to environmental sustainability, demonstrating the system's feasibility as a practical and affordable approach to energy recovery.

**Keywords:** waste heat recovery, gas water heat exchanger, thermal performance analysis, Levelized Cost of Energy (LCOE)

## **IOT Monitoring for Prompt Corrective Action for Optimizing Heat Exchanger**

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This project presents the design and implementation of an IoT-integrated dual-cycle heat recovery system aimed at maximizing thermal efficiency in small-scale thermal power plants. The system comprises two main cycles: an air-blown combustor that channels flue gases through a heat recovery steam generator, and a water loop that pumps fluid through a heat exchanger to reclaim thermal energy. While the mechanical design optimizes heat transfer, the project's core innovation lies in its Internet of Things (IoT)-enabled monitoring and control system.

Utilizing an ESP32 microcontroller as the central node, the system integrates DS18B20 digital temperature sensors, MAX6675 thermocouple modules, and YF-S201 flow meters to collect real-time data from both cycles. These readings are transmitted to the Arduino IoT Cloud, where data is displayed via a web dashboard with interactive gauges and charts. This allows remote monitoring of air and water temperatures, flow rates, and system status.

Through precise sensor integration and live monitoring, the team was able to tune system parameters for optimal performance. The system achieved a water temperature increase of 31.556°C and a flue gas cooling of 117.25 °C, reaching a heat recovery efficiency of 92.5%. The net heat gain recorded was 34.6 kW, validating the effectiveness of the heat exchanger and combustion system. The ability to visualize these values in real time was key in verifying performance, adjusting flows, and improving operational efficiency.

A major enhancement is the full actuator control via the web dashboard, enabling remote operation of the blower, pump, and valves. This replaces manual interventions and enables faster, safer responses. To further automate the system, a PID (Proportional-Integral-Derivative) controller is proposed for future implementation. It would dynamically adjust fan and pump speeds based on temperature feedback, maintaining thermal balance and minimizing energy loss. Future versions could also integrate ML-based predictive control.

The system includes a fault detection module that identifies abnormal flow conditions, temperature spikes, or sensor failures. It can trigger alarms or shut down components, protecting the system from damage and supporting predictive maintenance. All data is logged continuously to support trend analysis and optimization over time.

Cybersecurity considerations were also addressed to ensure data integrity and prevent unauthorized access. Role-based access control was implemented on the Arduino IoT platform: only one designated engineer account has editing privileges, while others can monitor the system in view-only mode. This ensures that only qualified personnel can alter system settings, greatly reducing the risk of accidental or malicious interference. For industrial deployment, further enhancements like data encryption, multi-factor authentication, and network firewalls are recommended.

The control architecture includes a manual override option, allowing local operation in case of internet failure. A future upgrade involves integrating a fuel flow sensor to optimize combustion efficiency. Another innovation is the proposed remote-controlled ignition circuit, which allows digital ignition of the combustor, improving operational convenience and safety.

Beyond the lab, this model can be adapted to industrial applications requiring heat recovery and precision control. In the oil and gas sector, similar setups could improve efficiency in flaring systems or exhaust heat recovery units. The principles of sensor-based feedback, control automation, and secure access apply to a wide range of industrial thermal systems, including chemical plants and HVAC facilities.

The implementation process included hardware selection, PCB design to organize wiring, sensor calibration, and code development using Arduino IDE. Emphasis was placed on using widely available components with strong compatibility and real-time dashboard updates. The result is a robust, user-friendly system that offers both technical accuracy and practical usability.

In conclusion, this project successfully demonstrated that integrating IoT into a dual-cycle heat recovery system can significantly enhance thermal efficiency, system responsiveness, and operational safety. The system's modular design, real-time data tracking, remote control capabilities, and embedded security make it a promising model for sustainable industrial energy solutions. Future work should aim to industrialize the platform by adopting hardened components, implementing full cybersecurity protocols, and expanding the automation logic to support variable loads and predictive diagnostics.

**Keywords:** IoT, energy auditing, automation, thermal efficiency, monitoring, security, control, sustainability



## **The Increasing Global Demand for Sustainable Energy Solutions has Placed Significant Emphasis on Improving the Efficiency of Thermal Systems**

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The increasing global demand for sustainable energy solutions has placed significant emphasis on improving the efficiency of thermal systems. This project addresses one of the major inefficiencies in any source of heat utilities or industrial facility: the loss of heat energy through flue gases (waste energy). The proposed solution is the design and implementation of a waste heat recovery unit using a heat exchanger that utilizes exhaust gases to heat up utility water for daily use for sustainable and efficient thermal systems.

The purpose of the research was to reuse waste heat from thermal utilities sustainably, minimizing carbon footprint and reducing costs by improving utility efficiency through our design of a Waste Heat Recovery Unit (WHRU). This involved creating a small-scale prototype integrating a combustion system and real-time IoT monitoring. The primary objective was to raise water temperature by over 30 °C using residual heat from combusted flue gases, demonstrating the viability of such systems in reducing industrial heat waste and enhancing thermal efficiency. To further maximize the impact of recovered heat, future applications should redirect this energy to support sustainable agriculture. Heated water or air can maintain optimal greenhouse conditions for year-round crops, stabilize fish farm temperatures to boost aquaculture, or heat livestock shelters to improve welfare and cut energy costs. These integrations promote circular energy use, extending the benefits of heat recovery into food production and rural sustainability.

The project methodology was multidisciplinary, combining mechanical design, combustion modeling, thermodynamic analysis, IOT integration, and hands-on manufacturing. It involved a test setup where exhaust heat from a chimney was simulated by a combustion product quenched by ambient air, resulting in warm exhaust gases at around 200 °C. A heat exchanger for heat recovery was designed to minimize exergy destruction. The output of the optimization was the basis of the selection of a locally available heat exchanger. The purchased heat exchanger was integrated into the system. The resulting temperatures were monitored through sensors and IOT till reaching the steady state of pumping water through the pump into the heat exchanger, aligned also with the speed of a compressor, giving the flow rate of the flue gases in the High-temperature resistant ducting that were selected using fluid dynamic calculations and thermodynamic matching between compressible and incompressible flows.

CFD simulations and EES analysis validated thermal and fluid behavior, ensuring optimal performance and efficiency. These modeling tools guided heat exchanger design by predicting flow, temperature, and pressure drops, improving manufacturing and reliability.

Results showed a 31.5 °C water temperature rise, 117.25 °C flue gas cooling, and 92.5% heat recovery efficiency. Despite a 21.3 kW heat transfer rate, overall efficiency was 3.54% due to scale and material limits. The 3,939 Pa pressure drop (46.5%) highlighted the need for proper fan sizing.

To further improve performance and reliability, several key recommendations are proposed. Implement PID control to dynamically adjust blower speed, pump flow, and heat exchanger output based on temperature feedback, automating operation and boosting efficiency. Add fault detection for no-flow or sensor failures to protect equipment. Enhance the IoT dashboard with toggles, sliders, and indicators for intuitive use, along with data logging for long-term analysis. Include manual overrides for greater robustness. Integrate energy and fuel monitoring to assess real-time efficiency and link thermal output to fuel use. Finally, explore machine learning to predict and adapt operating parameters.

In conclusion, this project demonstrates a sustainable, efficient approach to recovering waste heat from industrial combustion, showing the potential of WHRUs to cut energy losses and environmental impact. By combining mechanical design, IoT, and thermodynamic optimization, the system achieved high heat recovery efficiency and significant water temperature gains, offering a practical way to boost energy use in thermal systems. Such solutions support global goals of reducing carbon footprints and conserving resources, highlighting engineering's role in advancing sustainable industry. Future improvements in automation and smart monitoring will further enhance system reliability and make WHRUs a scalable option for greener energy.

In summary, this research validates the feasibility of an integrated, sensor-driven heat recovery system that is cost-effective, educationally valuable, and scalable. It sets the foundation for future development in smart, sustainable thermal systems.

**Keywords:** thermal efficiency, energy auditing, carbon footprint reduction, smart industrial solutions, exergy optimization, IoT integrated monitoring

## Plant Genetics Under Heat Stress: Building a Climate-Resilient Future

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As global temperatures continue to rise, heat stress has emerged as one of the most pressing environmental challenges affecting plants worldwide. This increasing heat not only hampers plant growth but also drastically reduces crop productivity, posing a significant threat to global food security. With millions of people dependent on stable agricultural systems, understanding how plants respond and adapt to heat stress has become critically important. Plants cannot escape their environment, so they rely on complex internal mechanisms to detect and survive stressful conditions. One of the key ways plants do this is by changing the way their genes are expressed.

Gene expression allows plants to convert DNA instructions into molecules needed for growth and survival. A key early step, transcription, copies genetic code into RNA. How this process is regulated under heat stress remains unclear. Our research explores how plants maintain accurate transcription when exposed to high temperatures.

Central to this process is an enzyme called RNA Polymerase II (RNAPII), which is responsible for reading genes and producing RNA transcripts. Under normal conditions, RNAPII operates with high precision and efficiency, ensuring that the right genes are expressed at the right times. However, our previous studies have shown that elevated temperatures can interfere with the normal function of RNAPII. Heat stress often causes RNAPII to slow down or even stall, disrupting the transcription process. When this happens, plants risk losing the ability to properly produce the RNA molecules necessary for survival and adaptation.

To overcome this challenge, plants appear to have developed specialized cellular mechanisms that detect stalled RNAPII and promote its recovery, allowing transcription to continue smoothly. Our current research is focused on identifying and understanding these mechanisms. We are particularly interested in the role of RNA processing components, which may assist in stabilizing RNAPII activity and ensuring the production of high-quality RNA molecules even under heat stress. By studying these factors, we hope to uncover how plants protect their genetic integrity and maintain gene expression during periods of extreme temperature.

Our work uses *Arabidopsis thaliana* as a model organism. This small flowering plant is widely used in genetic and molecular research due to its short life cycle, well-characterized genome, and similarity to many crop species. Using *Arabidopsis*, we employ a variety of molecular biology techniques to observe changes in gene expression and RNA processing under controlled heat stress conditions. These methods include monitoring the activity and behavior of RNAPII, analyzing RNA transcripts, and assessing how efficiently plants recover their transcriptional processes after exposure to heat.

While our results are still preliminary, they suggest that plants engage a coordinated response to help RNAPII overcome heat-induced interruptions. This response appears to support the continued production of essential RNA molecules, particularly those involved in coping with stress. Disruptions to this recovery process may lead to decreased plant fitness and reduced ability to survive harsh

environments. Thus, understanding how transcription and RNA processing are maintained under heat stress could be key to improving plant resilience.

The broader implications of our research are significant. Climate change is expected to increase the frequency and severity of heat waves, making heat stress a growing threat to agriculture worldwide. By revealing the molecular details of how plants manage gene expression under heat stress, our study aims to contribute foundational knowledge that can be used to develop crops better equipped to withstand such conditions. This could involve breeding or engineering plants with enhanced transcriptional stability, ultimately leading to more reliable food production in a warming world.

In a nutshell, our research addresses a critical gap in understanding how plants regulate gene expression at the transcriptional level during heat stress. By focusing on RNAPII and the RNA processing machinery, we aim to uncover the natural strategies plants use to preserve their genetic activity under challenging environments. The insights gained from this work will be valuable for future efforts to strengthen crop resilience, helping to safeguard global food systems in the face of climate change.

**Keywords:** abiotic stress, transcriptional regulation, gene expression, climate resilience

## Safeguarding Plant Gene Expression Under Heat Stress: Molecular Mechanisms Supporting Resilience in a Changing Climate

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Climate change is emerging as a defining challenge for both natural and agricultural systems, with rising global temperatures exerting pressure on plant communities worldwide. Heat stress, in particular, threatens the survival, growth, and reproductive success of plants in their natural habitats, while simultaneously endangering the productivity of vital cereal crops. As a result, understanding how plants withstand thermal stress is essential for both **nature conservation** and sustainable food production, two pillars of environmental resilience in a warming world.

At the molecular level, heat stress disrupts one of the most fundamental processes in plant biology: **gene transcription**, the conversion of DNA into RNA by RNA Polymerase II (RNAPII). This process is inherently sensitive to environmental fluctuations. Elevated temperatures can cause RNAPII to pause or stall by amplifying natural roadblocks such as tightly packed chromatin, DNA damage, or misincorporated nucleotides. These disruptions result in incomplete or faulty RNA transcripts, potentially leading to dysfunctional proteins and weakened stress responses.

In this study, we investigated how plants maintain transcriptional integrity under heat stress by focusing on *Arabidopsis thaliana*, a model organism widely used to dissect complex genetic pathways. Using a combination of genetic and molecular approaches, we examined the role of **transcription elongation factors**, which are known to assist RNAPII in overcoming transcriptional challenges. Our results revealed that *Arabidopsis* mutants lacking specific elongation factors exhibited heightened sensitivity to elevated temperatures. These mutants also accumulated aberrant RNA transcripts, indicating that the absence of these support systems severely compromises transcriptional fidelity and downstream gene expression.

To extend the ecological and practical relevance of our findings, we validated key aspects of this mechanism in **barley (*Hordeum vulgare*)**, one of the most important cereal crops cultivated in diverse outdoor environments across the globe. Barley is not only critical for food and feed but also plays a role in supporting **agrobiodiversity and rural livelihoods** in marginal and stress-prone ecosystems. Our barley experiments confirmed that homologs of the transcription elongation factors identified in *Arabidopsis* are likewise crucial for thermal tolerance. Barley plants with reduced expression of these genes demonstrated increased vulnerability to heat, including impaired growth and signs of transcriptional disruption, thereby validating the conserved nature of these protective molecular pathways across species.

This dual-species approach strengthens the link between **molecular stress responses and field-level resilience**, allowing us to bridge basic plant science with applied conservation and agriculture. From a nature conservation perspective, understanding how plants maintain core cellular processes like transcription under environmental stress is fundamental to preserving wild species that are often exposed to extreme or fluctuating conditions in their native habitats. For example,

plants growing in high-altitude, arid, or semi-natural grassland ecosystems must possess inherent molecular safeguards to survive repeated heat events mechanisms like those we describe here.

Simultaneously, these findings hold major implications for agriculture. By targeting conserved transcriptional support factors, we can guide the development of **climate-resilient crops**, particularly cereals like barley that are directly threatened by climate variability. This knowledge can inform breeding strategies, restoration of native crop relatives, and selection of robust varieties for cultivation in environmentally sensitive regions.

In conclusion, our work highlights the critical role of transcriptional resilience in ensuring plant survival under heat stress. By decoding the molecular mechanisms that allow both wild and cultivated plants to cope with rising temperatures, we provide insights that are directly relevant to **nature conservation, outdoor ecosystem stability, and agricultural sustainability**, all of which are vital to protecting plant life in an era of accelerating climate change.

**Keywords:** RNAPII, transcription, RNA quality control, heat stress, plants

## **HSF1 Functions in Alleviating ER-stress in *Caenorhabditis Elegans* and Human Cell Lines**

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Cells can be exposed to many different stimuli that induce a variety of stresses, such as oxidative stress and proteotoxic stress of the cytoplasm, endoplasmic reticulum, or mitochondria. These types of stresses trigger conservative molecular pathways (e.g., heat shock response, unfolded protein response, and autophagy) that can restore cellular homeostasis of the affected cell. Dysfunction (deficiency or hyperactivity) of these pathways is associated with aging and age-related diseases such as neurodegenerative disorders, diabetes, and cancer. The basic molecular machinery of these stress response pathways has been elucidated, but how these pathways interact remains a vibrant area of research.

Here, we show that the heat shock transcription factor HSF-1 is required for efficient activation of the endoplasmic reticulum unfolded protein response (UPRER) upon heat shock and ER stress in *Caenorhabditis elegans*. We also show that nematode tunicamycin-induced ER stress tolerance depends on HSF-1 activity. Finally, we found that mRNA levels of several genes involved in the UPRER are regulated by HSF-1 in the human cell lines HEK-293T and HT-1080. Taken together, our results suggest that HSF-1 plays a critical role in the UPRER in both the nematode *C. elegans* and human cell lines.

**Keywords:** stress, UPR, *C. elegans*, aging, tunicamycin