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Professional paper

PRESERVING THE PAST, SHAPING THE FUTURE: HERITAGE-BASED STEM WORKSHOPS IN IVANIĆ-GRAD, CROATIA

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Integrating local heritage with STEM education presents a valuable opportunity to enhance community engagement and promote sustainable development. Recognising this potential, the Friends of Heritage Association initiated STEM and Heritage Workshops in 2023. Designed for secondary school students in Ivanić-Grad, Croatia, these workshops aimed to bridge STEM disciplines with cultural heritage, equipping participants with essential skills to support the growth of creative and cultural industries. Throughout the programme, students engaged in hands-on activities such as documenting and digitising artefacts for a virtual museum, creating 3D models and prints of historical sites, mapping natural heritage using QGIS, and analysing bioarchaeological material. These experiential learning opportunities emphasised STEM's crucial role in the social sciences and humanities, underscoring the necessity of interdisciplinary collaboration for heritage preservation and innovation. The workshops' goal was to inspire, empower, and actively involve young people in heritage projects, fostering cultural awareness and encouraging participation in heritage-related scientific disciplines. This approach highlighted the importance of interdisciplinarity in achieving meaningful outcomes by leveraging digital tools to enhance the study, appreciation, and preservation of local cultural heritage. This paper provides an overview of the implemented workshops, outlining their methodology and key results.

Keywords: local heritage, STEM, workshops, community, non-governmental organisation

INTRODUCTION

The Friends of Heritage Association (hereafter referred to as the Association) was founded in 2005, focusing on preservation, promotion, and valorisation of the cultural and natural heritage of the broader Ivanić-Grad area. Through various projects, educational programmes, and volunteer activities, the Association seeks to raise awareness of the importance of heritage and encourage the local community to engage in its joint preservation and sustainable use through a bottom-up approach. The Association consists of a diverse and interdisciplinary group of enthusiasts, heritage lovers, and experts in fields such as history, archaeology, ethnology, landscape architecture, architecture, art history, sociology, museology, economy, management, and philology. Over the past twenty years, the Association has organised and con-

ducted numerous workshops, lectures, conferences, exhibitions, and research activities, introducing the broader local community to the region's cultural, historical, and natural values, with a recent shift towards youth education and integration. Through collaboration with local, regional, and national schools, museums, institutions, and authorities, the Association strives to involve a broad range of stakeholders in the heritage preservation, promotion, and revitalisation. The Association has been recognised and praised by the professional and academic communities as an outstanding citizens' organisation, owing to its role as a cohesive link between the local community and heritage (Cepetić and Matker 2011; Odak 2024; Limani 2025).

One of the Association's most significant milestones was the initiative to establish a museum, which led to the Ivanić-Grad Museum, founded by the City of Ivanić-Grad in 2014. The Museum continues to operate as the leading professional institution for local cultural and historical heritage to date. Despite this achievement, the Association remains actively involved in community projects, working alongside the Museum and the local Tourist Board, its two key partners in the cultural development of Ivanić-Grad. Another crucial milestone in the Association's growth has been collaborating with the international organisation European Heritage Volunteers since 2019. This partnership has enabled the Association to expand its reach and establish itself on the international map of European heritage stakeholders. These rich experiences throughout the Association's existence were developed thanks to the cooperation of enthusiasts and heritage lovers from various professional backgrounds. For this reason, the Association has embraced an interdisciplinary approach from its very beginnings, utilising tools from various sectors to carry out its activities, long before STEM fields were fully recognised for their significance as they are today.

ABOUT THE "STEM AND HERITAGE WORKSHOPS" PROJECT

Due to a broad variety of heritage-oriented topics throughout different activities in the last 20 years, the Association has obtained extensive experience with interdisciplinarity of the team members, each contribut-

ing with new insights from their different professional problem-solving skills and approaches. The diversity of members included the work between ethnologists, museologists, sociologists, historians and art historians, archaeologists, biologists, architects, and landscape architects. In the first fifteen years, the Association focused on strong professional work combined with civil activities, in order to lay the foundation for the growth of the cultural sector in Ivanić-Grad. Over the last five years, the Association, a non-governmental organisation (NGO), has been shifting in the direction of heritage promotion and education of the local public, to bring a level of sensitivity, interest, and responsibility towards heritage to the broader population. With this shift, the NGO set a new goal for educational and hands-on activities with the target group of the young population and students in Ivanić-Grad.

With this new goal in mind, alongside the vast interdisciplinary experience, the concept of STEM workshops emerged as the most profound tool, since education in the STEM industry is recognised as essential for developing problem-solving skills and the practical application of knowledge in overcoming real-world obstacles. STEM education emphasises learning through hands-on application and provides a framework for developing a deeper understanding of issues, building confidence, improving literacy, and enhancing social and communication skills such as conflict resolution, creative thinking, problem-solving, and strategic planning (Orr et al. 2021).

The topics developed for the workshops were chosen to be the most fitting for the described learning process, taking into account the members' different professional backgrounds and studies. Also, they were inspired by broad activities from Friends of Heritage portfolio, challenging different topics like: 3D modelling, urban planning and design (3D modelling of the Ivanić Fortress model in the city park; secondary school workshops "Summer School of Heritage and Architectures"; conceptual design for the Milka Trnina Cultural Centre (*Dom kulture Milke Trnine*), 3D modelling of the historical church interior), environmental protection and promotion of natural and rural heritage (geographic information system (GIS) mapping and digital storage of natural heritage; orienteering workshop for children using maps; integration of heritage elements into rural space through "Heritage Cycloroute"

(*Baštinska ciklotura*); design and implementation of heritage elements into contemporary rural landscape with "Posavina Corn Maze"), historical and archaeological research (map analysis and field survey in Kloštar Ivanić; archaeological excavation of the Ivanić Fortress), and documentation and digitisation of objects (digitisation of local firefighting heritage objects; documentation and digitisation of industrial heritage objects for the Virtual Museum of Industrial Heritage; establishment of the inventory of the Kezele family ethnographic collection).

Taking these topics into account, in December 2023, the Association launched an initiative titled "STEM and Heritage Workshops" funded through a public grant from Zagreb County, Croatia.[1] The primary objectives were to foster interdisciplinary collaboration, engage secondary school students in heritage-related projects, and introduce them to diverse STEM-based methods and career opportunities in the cultural sector. All workshops were created in cooperation with members of the Association. Their common goal was to demonstrate the applicability of STEM skills in cultural heritage through the active participation of students. The workshops were designed with regard to the members' professional backgrounds since they needed to have prior knowledge in the field that they are teaching. It was also important to demonstrate the interdisciplinary nature of cultural heritage, and its potential to connect with other scientific fields, such as technical sciences, informatics, and biology. Based on these principles, four workshops were created:

- "Documentation of Industrial Heritage Objects and the Virtual Museum";
- "3D Modelling and Printing in Heritage";
- "Mapping Natural Heritage Using QGIS";
- "Biology in the Humanities – Introducing Bioarchaeology and Zooarchaeology".

Teaching strategies for every workshop were designed following the framework and principles of STEM workshops. It was important to provide hands-on interactive experience for students through mentoring, teamwork, and conversation exchange, as well as to present the

[1] We would like to express our sincere gratitude to Zagreb County for their financial support of our project in 2023.

complexity involved in integrating cultural heritage with STEM fields through educators' speech. Guided by the recommendations of educators, the project was held during four weeks, one workshop per week, for two school hours in the afternoon and aimed at the students of the local Ivan Švear Secondary School, where the workshops were carried out. The school setting was strategically chosen to target students at a formative stage, as they begin to consider their future academic and professional paths. "The STEM in Heritage Sciences" (HERISTEM) Erasmus+ project, led by the University of Belgrade and partnered with institutions from Zagreb, Ljubljana, Sarajevo, and Cambridge, served as a model for our local initiative (Vuković 2022: 9–15). While the HERISTEM Erasmus+ project focused on students already based in heritage disciplines, our initiative aimed to raise awareness of digital humanities among young people still choosing their university paths. Additionally, the NGO aims to strengthen the relations with local stakeholders, specifically with educational institutions like secondary schools, since they help spread knowledge and implement education on the importance of local heritage. Thus, the participants for four workshops were gathered by school managers. Each workshop consisted of six to ten students from the 2nd to 4th grade of different orientations. The school also provided the classroom and technical equipment in the form of computers and a projector, while one or two laptops were provided by Friends of Heritage lecturers, enabling students to work in groups on each laptop.

The local project addressed the increasing application of STEM technologies in the humanities, demonstrating how tools such as 3D modelling, 3D printing, GIS mapping, digital storytelling, and biochemical analysis can be utilised for cultural heritage preservation and innovation. Additionally, the project wanted to instil a sense of pride and identity in participants by grounding the workshops in their local heritage and to serve as a model for utilising STEM to innovate heritage preservation while inspiring the next generation to engage with the cultural sector, as proven in previous successfully delivered NGO activities. This included documenting objects from local industrial heritage and integrating them into a virtual museum, creating a 3D model of a historical fortress that once stood in the city, mapping local natural heritage through QGIS, and analysing bioarchaeological material excavated from a local archaeological site.

PEDAGOGICAL BACKGROUND OF WORKSHOPS

Workshops are a special type of educational programme designed for a specific group of people. What distinguishes them from school classes is their primary focus on practical work, the specific needs, interests, and preferences of the group involved. Biljana Radić-Bojanić and Danijela Pop-Jovanov (2018: 225) believe workshops are the best form of non-formal education because they actively involve participants, focus on interaction, and motivate them to understand a specific topic in depth. Despite all the advantages of the workshops as educational programmes, for this project, it was necessary to base each workshop on pedagogically appropriate didactic principles, strategies, and methods. The principle that guided all workshops is the principle of alignment (Hodolidou 2014: 190). When planning the workshops, learning goals, teaching methods and activities, and ways of evaluating acquired knowledge were coordinated so that they formed a coherent whole. Teaching methods and the evaluation strategies were chosen according to learning goals.

The first step was to define the learning goals of the workshops. They then served as a guide for designing activities, teaching methods, and evaluation methods. Accordingly, the following main goals were defined for workshops:

- "Documentation of Industrial Heritage Objects and the Virtual Museum" – participants will document objects for a virtual museum through WordPress;
- "3D Modelling and Printing in Heritage" – participants will create a 3D model in SolidWorks and print the model through UltiMaker Cura and Ender-5 Pro;
- "Mapping Natural Heritage Using QGIS" – participants will map natural heritage using Quantum GIS software;
- "Biology in the Humanities – Introducing Bioarchaeology and Zooarchaeology" – participants will analyse animal remains and write a lab report.

The objectives of the workshops were set in such a way that participants were expected to acquire skills. Accordingly, appropriate teaching methods were selected. The methods used were the conversation

method, the demonstration method, and the method of practical work (Cindrić et al. 2016: 151–164). To introduce new skills and knowledge to participants, the educators started the workshops with a conversation, connecting previous knowledge with new information that would be acquired through the workshop. Using the demonstration method, they showed how new skills were practically performed, and finally, the participants worked on projects themselves. To achieve experiential learning, exchange of opinions, and cooperation, the teaching strategies of mentoring and teamwork were used (Cindrić et al. 2016: 169–204). During practical work, the participants always worked in pairs to feel more secure in trying new skills while educators provided them with guidance. Workshops of this type are almost always designed according to the experiential learning model. They are focused on acquiring skills, not just on transferring knowledge. Collaborative and experiential learning are encouraged, and the emphasis is on experiencing and understanding knowledge (Martinko 2012: 165).

Having defined the main teaching objectives and appropriate teaching methods, the individual workshop activities and their duration were developed. Particular attention was paid to regular changes in activities and teaching methods to ensure maximal concentration of participants, given that the workshops lasted 90 minutes. The basic structure of the workshops was as follows: introduction and presentation, connecting new information to familiar, and demonstrating the skills that the participants will acquire – the demonstration method, practical work method, evaluation of acquired knowledge, and final evaluation of the workshop. Individual activities within each workshop will be presented in the following chapters. The final step was to define an evaluation strategy. Since workshops are a non-formal type of education, the strategy selected was informal evaluation. The informal assessment is only casually applied, which reduces student stress and the possibility of obtaining socially desirable responses. Educators evaluated through communication and observation.

STEM AND HERITAGE WORKSHOPS

DOCUMENTATION OF INDUSTRIAL HERITAGE OBJECTS AND THE VIRTUAL MUSEUM

As museums play a key role in preserving heritage and educating future generations, virtual museums have emerged as a digital alternative, allowing global access to artefacts and interactive learning experiences (Schweibenz 1998; Utkugün and Yıldırım 2024: 441). Virtual museums are interactive digital platforms that use computer and internet technologies to provide access to digitised artworks, historical artefacts, and documents in visual, audio, or video formats. With advancements in technology, they now exist as both websites and applications. These museums play a vital role in preserving cultural heritage through digitisation and making it accessible to future generations. By reaching wider audiences, they enhance learning experiences, promote cultural awareness, and foster intercultural understanding. Their global accessibility ensures the continuous sharing and sustainability of cultural heritage in the digital age (Utkugün and Yıldırım 2024: 442).

From 2019 to 2022, the Association led the project "Industrial Heritage of Ivanić-Grad", the first systematic study of the city's industrial development from the late 19th to the 20th century. The project aimed to raise awareness, promote interpretation and education, ensure sustainable management, and integrate industrial heritage into cultural tourism (Kantoci 2019: 178). Through two European Heritage Volunteers workshops, over 300 industrial heritage objects were documented. In 2019, the Virtual Museum of Industrial Heritage was launched through crowdfunding and crowdsourcing efforts, with objects continuously added to the museum. Due to limited funding, the Virtual Museum of Industrial Heritage was created as a WordPress website.[2] A structured format was established for adding objects, including key metadata such as: Name/Title, Place of Origin, Date of Origin, Materials and Techniques, Dimensions, and Ownership. Objects were categorised by the companies that operated at the time, but users can also search by

[2] The Virtual Museum of Industrial Heritage of Ivanić-Grad currently features 362 industrial heritage objects, with new items being continuously added (Amici hereditatis n.d.).

themes such as photographs, badges, and more. A unique feature of this virtual museum is that visitors can upload their own items through a form requesting specific details and a photograph.

The workshop to document and add industrial heritage objects to the virtual museum was held in a general secondary-school class. It was attended by six interested students, and led by Laura Šejić, a graduate archaeologist and museologist, and Katarina Matkerić, a graduate ethnologist, historian, and sociologist, both members of the Association (Figure 1). During the workshop session, participants gained insight into the process of documenting museum and heritage objects. They explored digital tools such as M++ and Microsoft Access for documentation and learned about the creation and significance of virtual museums.[3] A key component of the workshop involved practical engagement, where students contributed directly to the Virtual Museum of Industrial Heritage. The workshop began with an introduction to the concept of virtual museums, followed by a step-by-step guide on documenting objects, including essential metadata elements. The students were also introduced to digitising objects through scanning. However, for the purpose of this workshop, they captured photographs of the objects themselves. Each participant was assigned an industrial heritage object to document. They completed a detailed object identification form, took high-quality photographs of their respective objects, and uploaded the images to a shared digital folder. Following this, they were introduced to the WordPress software and guided through the structure of the virtual museum website. They followed the demonstrated steps and successfully added their objects, ensuring all metadata and images were correctly displayed. Upon completion, participants reviewed the website to verify the accuracy and completeness of their entries.

[3] M++ is the most used database for inventorying museum collections in Croatia.

Figure 1. The "Documentation of Industrial Heritage Objects and the Virtual Museum" workshop in progress (author: Laura Šejić).

Figure 2. Some of the documented and digitised industrial heritage objects during the workshop. Source: Screenshot from the Virtual Museum of Industrial Heritage of Ivanić-Grad (Amici hereditatis n.d.).

As a direct result of this workshop, over 20 industrial heritage objects were successfully documented and uploaded to the Virtual Museum of Industrial Heritage (Figure 2). Not only did this enrich the museum's digital collection, but it also provided students with valuable hands-on experience in heritage documentation and digital curation. The engaging and interactive session offered students a unique opportunity to connect with cultural heritage in a digital context while acquiring practical skills in museum documentation and online curation. They developed essential skills, such as digital literacy, through employing tools like digital photography and database management. Additionally, they learned heritage documentation by cataloguing artefacts and creating metadata for virtual collections.

3D MODELLING AND PRINTING IN HERITAGE

As part of the "STEM and Heritage Workshops" project, a workshop focusing on 3D modelling and printing was also held to integrate cultural heritage and technological innovations. The event took place at the Ivan Švear Secondary School in Ivanić-Grad during the evening hours and was attended by six students specialising in the Oil and Mining Technician programme. Two Mechanical Engineering Graduate students and Friends of Heritage Association associates on other projects, Artur Pocem Mihaljević and Rikardo Radešić, led the workshop. The interactive session provided students with a hands-on introduction to advanced digital tools and processes, highlighting their potential in both cultural and technical contexts. The workshop began with a theoretical and methodological 3D modelling and printing overview. Participants were introduced to two key software tools: SolidWorks and UltiMaker Cura. SolidWorks,[4] a powerful 3D computer-aided design (CAD) software (Greene 2021; SolidWorks Education Edition 2021–2022), was used to model the Ivanić Fortress, a historical structure significant to the city's local heritage (Rudež 1994). Students were guided through a step-by-step demonstration of the modelling process, which they followed on their computers. This approach simultaneously familiarised them with the software's features and emphasised the practical application of STEM skills in preserving and reimagining cultural landmarks.

[4] SolidWorks is a computer-aided design (CAD) software used for 3D modelling and engineering design.

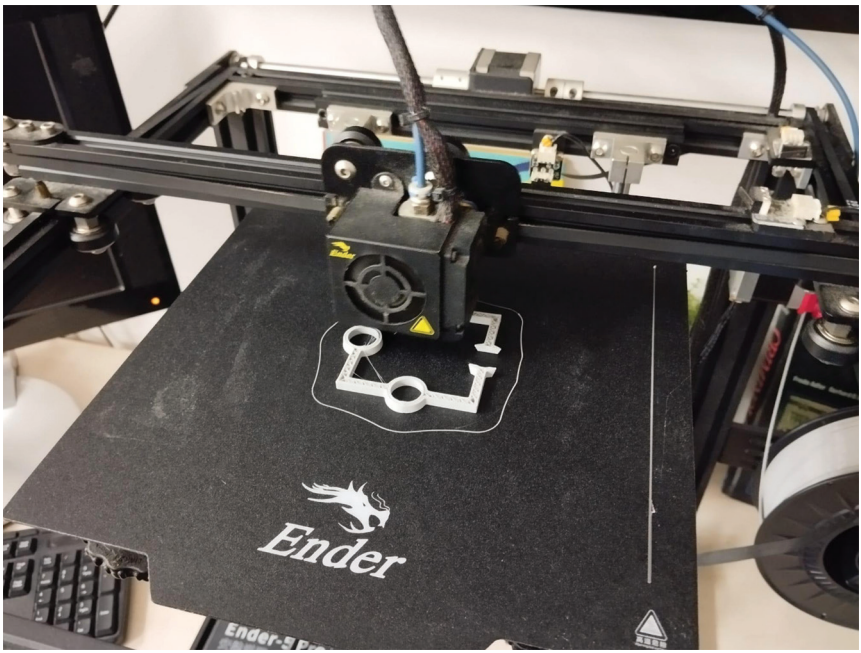

Figure 3. The process of printing the 3D model of the Ivanić Fortress using Ender-5 Pro (author: Laura Šejić).

Once the digital model of the fortress was completed, attention shifted to the preparation phase for 3D printing. This segment introduced students to UltiMaker Cura,[5] a slicing software essential for converting 3D models into printable files (Dhore et al. 2021: 212–213). Through detailed explanations and live demonstrations, participants learned how to configure parameters such as layer thickness, infill density, filament type, and print speed. These settings were contextualised within the broader framework of ensuring precision and efficiency in 3D printing. The process culminated in converting the model into G-code, the machine-readable format required by 3D printers (UltiMaker 2021). The final phase of the workshop featured a live demonstration of 3D printing using an Ender-5 Pro printer provided by the workshop instructors (Figure 3). Students observed the printer in operation, gaining insights into its core components and functionalities. They were introduced to

[5] UltiMaker Cura is a 3D printing software used to prepare digital models for fabrication. It has a CAD plugin integration with SolidWorks, Siemens NX, Autodesk Inventor, etc.

the mechanics of additive manufacturing and how digital designs are transformed into physical objects layer by layer. This hands-on experience was further enriched as students examined and interacted with the finished 3D-printed models of the fortress, providing them with a tangible connection to the technology and its capabilities.

Throughout the workshop, students were encouraged to ask questions and engage with the tools and processes, fostering an interactive and collaborative learning environment. The integration of cultural heritage into a STEM-focused activity offered participants a unique perspective on the interdisciplinary nature of modern technology and its potential to bridge diverse fields of study. This workshop not only introduced students to valuable technical skills such as CAD modelling and 3D printing but also inspired them to consider innovative applications of these technologies in heritage preservation. Moreover, the workshop demonstrated the potential of STEM education to empower students with practical, transferable skills that align with emerging technological trends. It provided students with a comprehensive, hands-on introduction to advanced tools while fostering an appreciation for the interplay between cultural and technical disciplines.

MAPPING NATURAL HERITAGE USING QGIS

The workshop's main premise was to introduce students to GIS, a comprehensive geoinformation tool within the technical field, applicable across various domains, including the cultural sector.[6] Almost all contemporary industries utilise GIS tools and principles, whether they actively work with them or are end users of their products. GIS finds applications in spatial planning and geography, landscape architecture and architecture, agriculture, transportation, energy and infrastructure, geology, geodesy, biology, and hydrology, as well as the cultural and social sectors like tourism, archaeology, and history. With the development of the internet and publicly available map viewers, GIS has gained popularity through interactive maps and interfaces, sparking

[6] GIS is an extensive umbrella term encompassing numerous theories, tools, methods, and systems related to the collection, processing, analysis, visualisation, and application of various spatial information.

public interest in spatial mapping. Examples of public web GIS applications include maps of castles, manor houses, and fortresses in Krapina-Zagorje County (Besednik 2023a; 2023b) and the natural and cultural heritage of Medvednica Nature Park (Karas 2023a; 2023b).

GIS tools play a significant role in heritage interpretation and visualisation in a spatial context, aiding in legislative protection and the enhancement of important heritage sites. To systematically inventory, evaluate, and preserve heritage, it is essential to manage it, with spatial planning documents serving as the fundamental management instrument for sustainable spatial development aligned with conservation (Radman 2014: 500). In the process of creating expert surveys for the preservation and management of natural and cultural heritage, GIS tools are among the primary instruments for collecting, reviewing, processing, and synthesising data on anthropogenic, natural, political, and social influences on heritage sites and areas (Spiridon et al. 2016: 269), ultimately enabling conclusions about human relationships with nature and space during time (Yao et al. 2023: 4).

The workshop took place for two school periods with ten students from the economics programme, and was coordinated by Kristina Komšo, a landscape architect. It consisted of two main parts: an introduction to GIS and the application of its tools, and guided group work on a practical task of mapping local natural heritage. In the workshop, a free and open-source GIS software, Quantum GIS, was used. The introductory part of the workshop focused on defining different types of heritage, with an emphasis on natural heritage, encouraging students to provide concrete examples of various types of heritage in their local community. Furthermore, there was a brief theoretical introduction to GIS, explaining its applications across different industries, including STEM fields. The use of GIS in Croatian cultural and nature conservation sectors was specifically highlighted, with examples such as the Geoportal of Cultural Property (Ministry of Culture and Media 2025) and Bioportal – web portal of the Nature Protection Information System (Ministry of Environmental Protection and Energy 2025). Additionally, the project "The Trees of Our City" by the Association was showcased as an example of a successful GIS tool application. This project resulted in the creation of a georeferenced database of the city's natural heritage

and ultimately led to the protection of several mapped units within the spatial planning documentation of the City of Ivanić-Grad (City Council of Ivanić-Grad 2024).

The second part of the workshop focused on the practical use of Quantum GIS, with students working in four groups of three. The workflow of this segment included: extensive activities for familiarisation with the programme, such as interface and tool overview, adding Web Feature Service (WFS) and Web Map Service (WMS) base layers, integrating pre-prepared spatial data, creating new spatial data (i.e., mapping), processing spatial data attributes, graphical processing, and visualising data by creating maps; and a hands-on mapping task focused on an element of Ivanić-Grad's natural heritage. Familiarisation with the Quantum GIS programme was intensive for students who had not previously encountered this type of computer work. However, they eagerly mastered the programme interface and several basic skills, such as adding WFS and WMS base layers and creating new spatial data. Due to time constraints and the number of coordinators, it was agreed that each group would work on the topic of the same natural element – a watercourse. Under the coordinators' guidance, the participants located and downloaded spatial data for all watercourses in the Republic of Croatia from an open-source platform, Bioportal (Ministry of Environmental Protection and Energy 2025). They imported this data into the programme, obtaining georeferenced watercourses of Croatia overlaid on the 2022 Digital Orthophoto Map (State Geodetic Administration n.d.). The acquired data was graphically processed by adjusting styles, and students were introduced to the attribute descriptions of a large set of metadata, including instructions on detecting attributes of the Lonja River. Finally, the students successfully created a new spatial dataset by mapping a specific element of Ivanić-Grad's natural heritage – a section of the Lonja River's watercourse in the urban centre (Figure 4).

Through the workshop process, students encountered spatial data manipulation and interpretation for the first time in their education, sparking curiosity, developing research skills, fostering creativity in visualisation and presentation, and enhancing their awareness of different spatial dimensions and their interpretation. A key advantage of group work was the fostering of a team-oriented environment for finding information, learning to use new tools, improving communication

within the group, and navigating the interface. However, some challenges hindered the quality of work with students, including the inadequate selection of participants based on their interest and skills, the lack of computer equipment and the need to group more students together for collaborative work. Additionally, the overall time limitation of the workshop allowed for only very general and simplified learning outcomes.

Figure 4. Mapping of the Lonja river in Ivanić-Grad. Source: 2022 Digital Orthophoto Map, State Geodetic Administration of the Republic of Croatia (author: Kristina Komšo).

BIOLOGY IN THE HUMANITIES – INTRODUCING BIOARCHAEOLOGY AND ZOOARCHAEOLOGY

During the workshop dedicated to biology in humanities, participants explored the biological and chemical methodologies that support archaeology and anthropology, contributing to the reconstruction of the past. Key disciplines were introduced, including archaeozoology, archaeobotany, osteoarchaeology, and scientific dating techniques for archaeological samples. The workshop's main objectives were to familiarise students with bioarchaeology and its interdisciplinary applications, introduce them to local heritage and archaeological sites, and explore the possibilities for interdisciplinary careers and projects. The workshop leaders, archaeologist Laura Šejić and molecular biologist Ana-Marija Petrović, provided in-depth knowledge of laboratory procedures and proper handling of samples. Eight gymnasium students participated in the workshop, engaging in discussions and hands-on activities related to bioarchaeology. During the workshop, zooarchaeological

material from a local site was used, along with laboratory equipment such as gloves, tweezers and brushes provided by the association. The workshop commenced with a brief lecture on bioarchaeology, providing participants with foundational knowledge of the field during the group discussions. After the lecture, the students learned to analyse archaeological remains and handle samples in the laboratory through practical group activities. A Q&A feedback followed the workshop.

Bioarchaeology is the study of both human remains and accompanying biological material in their past or cultural context. Today, bioarchaeology encompasses fields of palaeobotany (archaeobotany), zooarchaeology (archaeozoology) and biological anthropology (Larsen 2015). The workshop participants were briefly introduced to the mentioned fields and examples of interdisciplinarity between biology and archaeology. For example, isotope analysis provides insights into ancient diets, while ancient DNA analysis helps reconstruct migratory patterns of past populations. In palaeochemistry, trace elements and stable isotopes in teeth and bone remains can be used to reconstruct ancient diets and agricultural practices (Reed 2008). In an archaeological context, mitochondrial DNA (mtDNA) is particularly useful for studying genealogical relationships, as well as connections between individuals discovered at the same archaeological site (Zupanič Pajnič 2019). Both zooarchaeology and biological anthropology use osteological analysis (Reed 2008). Osteoarchaeology, or skeletal analysis, is the cornerstone of bioarchaeology, providing insight into the life and death of ancient populations. It is possible to determine an individual's age, sex, health, diet, disease, and cultural practices from skeletal fragments. Additionally, since bones are living organs, we can infer from the nature of the bone fracture and its placement whether the fracture happened before or after death. The term archaeozoology refers to the study of archaeological animal bones. Macroscopically, it is quite easy to distinguish human bones from other animal bones found at archaeological sites (Mulhern 2014). These morphological distinctions were employed in the workshop lecture and hands-on activity.

Before the activity, the students were introduced to essential laboratory requirements, including the proper use of gloves, appropriate clothing, and adherence to laboratory safety rules, ensuring a safe and effective learning environment. As part of the practical session, the students analysed zooarchaeological remains from the local archae-

ological site Ivanić Fortress, excavated in 2023,[7] to demonstrate the similarities and differences between human and animal bones. This involved sorting bones, classifying them by type (long, short, flat, and other), and identifying the corresponding animal species. The students managed to easily classify and identify the animal species by examining the skulls and the size of the bones, using key morphological characteristics to make their determinations (Figure 5). After the activity, the students wrote a lab report to document their findings and analysis. They also participated in a short knowledge quiz to assess their understanding of the concepts covered during the workshop. The knowledge quiz was designed to be relatable and engaging for the participants, incorporating questions about popular forensic TV series and other familiar topics. This approach made the quiz more accessible and fun, while still reinforcing key concepts from the workshop.

Figure 5. Students analysing the animal bones during the workshop (author: Laura Šejić).

[7] The Ivanić Fortress was excavated in 2023 and 2024 by the Association in collaboration with the City Museum of Ivanić-Grad. The zooarchaeological remains and other archaeological finds from the excavations are stored in the museum.

The workshop's success was clearly demonstrated through the participants' active inquiries about enrolment in specific academic programmes, associated obligations, and potential career opportunities. Many participants expressed that not only did they enjoy the workshop, but that it also felt highly engaging, sparking a keen interest in further exploring topics such as zooarchaeology and human osteology. Additionally, several participants inquired about pursuing studies in biology and archaeology, reflecting the strong curiosity and engagement the workshop generated. The students also expressed interest in the local archaeological site and ongoing excavations, recognising it as a key part of their heritage, which they encounter daily.

CONCLUSION

Through a series of workshops with lectures and hands-on activities the participants learned the fundamentals of digital tools and scientific principles within the humanities, and simultaneously gained a deeper understanding of their local heritage. These activities were designed to highlight the relevance of STEM in everyday life and its historical context, thereby bridging the gap between the past and the present. Following appropriate pedagogical principles, strategies, and methods, each workshop was carefully developed. The foundation of the workshops was the principle of alignment, where every learning goal is consistent with teaching methods and evaluation strategies. Teaching strategies such as mentoring and teamwork were combined with teaching methods of conversation, demonstration, and practical work.

At the workshop "Documentation of Industrial Heritage Objects and Virtual Museum" participants explored the process of documenting museum and heritage objects, using digital tools to contribute to the Virtual Museum of Industrial Heritage. They gained hands-on experience in digital photography, database management, and cataloguing artefacts with metadata, enhancing their digital literacy. During the "3D Modelling and Printing in Heritage" workshop, students used SolidWorks to create a digital model of the Ivanić Fortress. They learned to prepare the model for 3D printing using UltiMaker Cura and observed a live demonstration with an Ender-5 Pro printer. This hands-on expe-

rience introduced them to CAD modelling and 3D printing while showcasing the potential of these technologies in heritage preservation. The "Mapping Natural Heritage Using QGIS" workshop highlighted GIS applications in various industries, including heritage. Participants mapped the Lonja River's watercourse in Ivanić-Grad's urban centre, developing research skills and spatial awareness. Lastly, the "Biology in the Humanities – Introducing Bioarchaeology and Zooarchaeology" workshop provided insights into biological and chemical methods used in archaeology. Participants engaged in hands-on analysis of zooarchaeological remains from the Ivanić Fortress excavations. Their strong engagement and curiosity sparked interest in further studies in biology and archaeology. These workshops bridged the gap between cultural heritage and modern technology, fostering interdisciplinary learning and hands-on experience for young participants.

The final segment of each workshop was dedicated to evaluation. Facilitators evaluated the knowledge that the students had acquired using informal evaluation strategies such as conversation and observation. Students were encouraged to talk about their experience and share the results of their work. An in-person evaluation concluded that, through well-thought-out workshops based on an interactive approach, the students have acquired specific skills and knowledge related to each workshop. They demonstrated understanding and knowledge of modern technology, as well as the skills of searching, collecting, and processing information, assessing its importance, and handling information through critical thinking. They have also developed learning competencies by broadening their career and professional horizons and planning group and team activities. As a result, they also developed their own sense of initiative and entrepreneurship. They were active in the learning process, asked questions during the workshops, and eagerly participated. Some participants expressed further interest in the Association's activities and later engaged in other projects. Some of them were already familiar with the presented software programmes and wanted to deepen their knowledge through workshops, while others actively inquired about specific faculties related to the workshop topics. "STEM and Heritage Workshops" demonstrated to young people that cultural heritage research can be approached in various ways, continually evolving with modern technologies, and is far from monotonous

or reserved solely for heritage enthusiasts. The school staff were thrilled that students had the opportunity to explore STEM activities focused on local heritage and that they could actively participate in hands-on workshops. Additionally, the workshops provided their lecturers a crucial experience in developing didactic skills on how to communicate professional concepts effectively, and find optimal ways to exchange knowledge. By doing so, the lecturers themselves have demonstrated the use of individual skills in creating greater local benefits, which surpass the individual interest where cultural conservation and promotion is concerned. Finally, with this experience, the NGO gained insight into the benefits and challenges of the used methodology, with the possibility of future improvement.

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