

Discover the Historical Munich Bridges Through a Gamified Mobile Walk

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Abstract. The paper presents a gamified, guided thematic mobile walk to visit selected bridges of Munich and discover their cultural heritage values. These sites along the Isar river represent significant historical, economical and architectural value for the town. The walk introduces the Isar flood of 1899, the history of Munich's bridges, and the town's new riverscape following the flood. The mobile application guides users along the Isar river; the location-relevant content, mini-games and AR exercises are automatically activated when participants approach the given site along the route.

Keywords: Disaster Preparedness, Game-Based Tools, Cultural Heritage, River Flood, Munich Cityscape.

1 Introduction

This paper presents a gamified mobile walk along the Isar river in Munich which was created in collaboration with UniBw M (University of the Bundeswehr Munich) and HUN-REN SZTAKI (HUN-REN Institute for Computer Science and Control) within the framework of the EU funded B-prepared project (Building PREPAREDness with Collaborative Knowledge Platform, Gamification, and Serious Game in Virtual Reality) (Székely et al., 2025, B-prepared project, 2026). The project is implemented by 15 partners from 12 different countries. B-prepared offers a cost-effective solution for building a culture of disaster preparedness with a multi-actor approach in realistic historical scenarios. The B-prepared ecosystem consists of four products: a freely accessible massive collaborative knowledge base and data hub (Disastropedia), a cooperative

multiplayer Virtual Reality (VR-prepared) serious game, an interactive gamified mobile app (IM-prepared) and a Learning Management System (RU-prepared) to effectively and comparably measure preparedness levels achieved by VR and/or mobile users on a unified scale. The walk is available in the IM-prepared mobile application.

We haven't found any other gamified mobile applications performing location-sensitive gamified training on disaster preparedness. Existing mobile games and learning applications on disaster preparedness for citizens are either survival games (Skyscraper: Room Escape [Escape Factory, 2025], Disaster Run [John Lyons, 2025], gamified learning applications for children (Earthquake Safety Tips [BabyBus, 2026]) or plain learning applications or information applications for adults (Disaster Ready [Cornerstone OnDemand, Inc., 2026]). LMS-managed learning applications only exist in professional training.

The Munich walk presents historical events and some locations hit by the Isar flood in Munich of 1899. The walk includes stations on the damage and destruction caused by the flood, as well as the immediate and much later measures for reconstruction and prevention. During the guided walk, users get acquainted with the history of the bridges across the Isar river starting from their construction to their latest reconstruction, as well as other historical sites such as Museum Island and a still active hydropower plant.

The Isar was fundamental to Munich's historical development because it was not simply a natural setting but the city's principal water infrastructure from the medieval period onward. Together with its natural branches and artificial canals, the river supplied water for domestic use; it was an important means of commerce, waste disposal, defense, and supported urban functions, while also providing hydropower for mills and other mechanical facilities in the preindustrial city. The Isar also linked Munich to wider exchange networks carrying various goods to and from the city (Winiwarter et al., 2016). Thus, the Isar was significant to Munich not only as the basis of its urban development, but also enabled the city to assert itself as a regional center of power within a wider system of resource flow and trade.

2 IM-prepared Mobile Application

The IM-prepared smart phone application (Fig. 2) is available on iOS (iPhone, iPad) and Android platforms. The application content was provided by B-prepared project partners and external stakeholders. The details for the guided walk named "Isar flood in Munich of 1899" were collected and elaborated by representatives of UniBw M. The content can be downloaded prior to use, therefore, it can be retrieved without Internet connection. Interactive online and offline maps were integrated into the application to facilitate on-site orientation. To download the application to your mobile, go to the following link: <https://guideathand.com/en/downloads/b-prepared> or use the QR code in Figure 1.



Fig. 1. QR code to download IM-prepared application.

The application belongs to the GUIDE@HAND mobile application family (<https://guideathand.com>) developed by the eLearning Department of SZTAKI (Institute for Computer Science and Control, Hungary). The application family can meet a wide variety of demands and trends of the present life. It consists of more than 70 multilingual offline applications running on smart phones and tablets and provides tools and interactive services for mobile exploration of places, events, organisations, cultural objects, etc. The content of the applications can be uploaded, stored, managed and maintained with the help of a Web-based Administration System (Márkus & Wagner, 2011).



Fig. 2. Screenshots from the application. a) Main menu b) Walks, c) Project participants.

Disaster preparedness content is provided to the users in the form of downloadable packages called “walks” (Czifra et al., 2019). The walk content is created based on

historical events. Understanding historical disasters fosters citizen foresight, preparedness, and resilience. It enables individuals and communities to anticipate risks, advocate for better policies, foster solidarity, and adopt sustainable practices. By learning from the past, citizens can transform tragedies into opportunities for growth, ensuring a safer and more resilient future. Altogether 17 disaster preparedness walks were implemented in 12 European countries. The walks can be categorized into two main groups in the IM-prepared application: gamified and non-gamified walks.

Gamified walks (Márkus et al., 2018) include various games such as mini-games and AR (Augmented Reality) activities besides POIs (Points of Interest). Five gamified walks were implemented in IM-prepared. All of them have multiple versions according to language, role and mode. They have a guided and a list-based version for on-site and distant mode, respectively. Two roles were implemented, namely citizens (for all age groups) and children (for children aged 11-14). We introduced the dedicated children's role, as children are particularly vulnerable during disasters. The gamified walks are available in English and the local language to ensure broader accessibility.

Non-gamified walks include neither games nor navigation. It allows users to explore the sights by selecting them from a list in any order. Twelve non-gamified walks were also implemented in the IM-prepared application. They are simpler than the gamified walks, and do not include games, AR activities, a route and navigation instructions. They may have different language versions, but all of them were implemented in the citizens role and in distant mode.

Mini-games are implemented in HTML5 and JavaScript. AR games are built using Unreal Engine (Epic Games). They are available in a separate mobile application named IM-prepared AR which should be installed before starting an AR game from the IM-prepared app.

3 Munich's New Riverscape after the Flood of 1899

Floods were a regular feature of the Isar. For the river reaching up to Munich, 89 floods have been identified between 1300 and 1900. Periods of particularly high flood frequency, with approximately one flood every three years, occurred around 1500, shortly before 1800, and shortly before 1900. These floods were caused primarily by long-lasting orographic rainfall rather than by snowmelt (Winiwarter et al., 2016). The flood of 1899 destroyed channelization works, weirs, the Maximilian hydropower plant built in 1895, and the city's two main bridges. In response, the municipal government and the local water agency initiated a large-scale regulation through channelization and the construction of new bridges between 1900 and 1905. This intervention fundamentally altered the riverscape (Zingraff-Hamed et al., 2022). Figure 3 shows the site of the Luitpoldbrücke after its collapse. An emergency bridge was built briefly after the flood (Wehrli, 1900a, 1900b).

Contemporary accounts present the 1899 flood as the moment when the need for "far-reaching questions of regulation" became unavoidable. In the years that followed, six new bridges were built across the Isar together with high "embankment walls and slopes" intended to protect the city against future flood damage (Halm, 1906). The new

bridges were conceived not merely as technical infrastructure but also as architecturally representative works. Being decorated with statues, reliefs, and other sculptural ornaments, they were also regarded as works of art. Although the bridges were designed in a similar style and with similar materials, contemporary commentary nevertheless distinguished among them aesthetically. The Maximilian Bridge was described as particularly richly ornamented, whereas others, such as the Reichenbach Bridge, were seen as more restrained. In this sense, the new Isar bridges acquired significance not only as hydraulic and transport infrastructure but also as symbolic works of civic representation in early twentieth-century Munich (Heilmeyer, 1907).

In the longer term, additional flood-protection measures followed. The Sylvenstein Dam, built upstream outside Munich between 1954 and 1959, was designed to store snowmelt and rainwater, while the Isar restoration project implemented between 2000 and 2011 was conceived as a nature-based flood-protection measure that also supported habitat restoration (Zingraff-Hamed et al., 2022).



Fig. 3. Collapsed Luitpold bridge after the 1899 flood (left) and “emergency bridge” constructed as a temporary replacement (right). Both images were cropped to content.
(Source: Wehrli, 1900a, 1900b).

4 Gamified Mobile Walk in Munich

The guided walk named as “Isar flood in Munich of 1899” navigates users along a given route of sights and presents location-dependent information about POIs along the route (Fig. 4). The walk is about 5 km long. It is available in two languages, German and English. During the walk, the POIs are automatically activated as the user approaches them due to the location service (Global Positioning System, GPS) of the device. Users get to know the history of a given bridge, the damages of the flood in 1899, the reconstruction and further developments. The user may read the description of the POI or listen to the narrated content. Contemporary and historical pictures illustrate the description. The walk includes the following POIs: Isar Flood of 1899, Max-Joseph Bridge / Bogenhausen Bridge, Emergency Bridge Bogenhausen, Luitpold Bridge, Maximilianswerk Hydropower Plant, Museum Island, Reichenbach Bridge, Wittelsbach Bridge, Isar River Restoration.

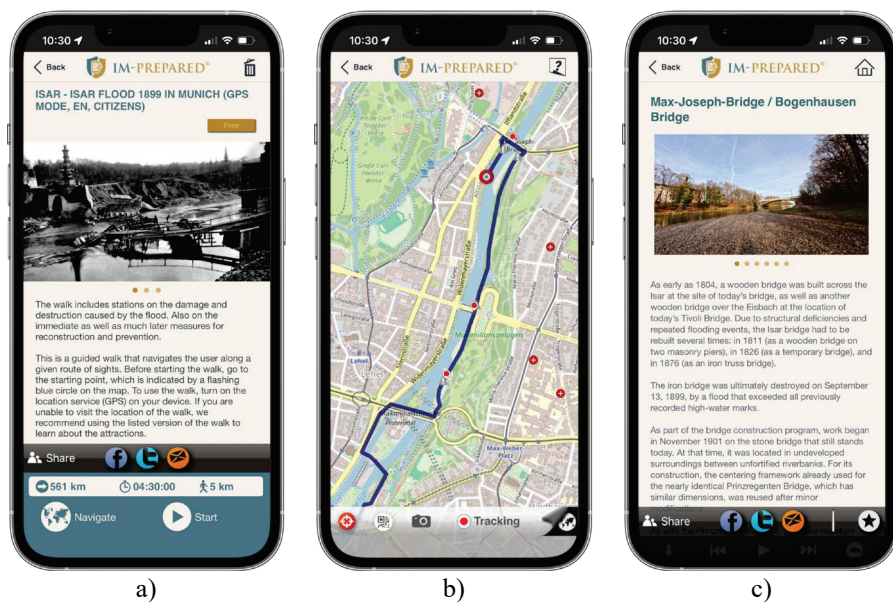


Fig. 4. Screenshots on the walk a) Data sheet b) Walk route c) Sample POI.

The users may not only passively receive information but may start various mini-games on the learned content. The walk includes the following game types: single-choice question, multiple-choice question, matching, ordering, word search, memory game (Fig. 5). The results of a completed game are forwarded to a central B-prepared server which creates a progress report from the data collected from different B-prepared products. The report provides a clear, consolidated view of the user's disaster preparedness journey across all B-prepared products, encouraging users to complete additional tasks. The results from the VR game, mini-/AR games, and learning activities are automatically converted into experience points (XP) and combined with achievements earned across other B-prepared products, creating a unified picture of the user's progress. A progress report named B-ready Report is generated, providing an overview of a specific user's preparedness level, including earned XP, collected badges, and completed tasks. Users can check their own progress in the B-ready Report across different B-prepared products after logging in.

If a user is unable to visit the location of the walk in Munich, the listed version of the walk is recommended to use. In this case, the user can select POIs from a list one by one, get information about a selected bridge and play games.

The walk content was created in a close co-operation of SZTAKI and UniBw M. SZTAKI developed the IM-prepared mobile application and provided continuous methodological support to UniBw M who collected the sources and developed the content. In accordance with walk content development processes defined by the IM-prepared development team, sources of the walk content were collected and placed by the content developer partner to a dedicated page in the Disastropedia.

The walk content has a fixed structure and it is defined by a walk script. The IM-prepared team provided a template for the script to UniBw M. The template includes the following information:

- general walk information (e.g., name, description, length, duration),
- default voices to start the walk (text, audio files),
- items of the walk (POIs: start location, sights, navigation instructions, end location).



Fig. 5. Games from the walk a) Matching b) Ordering c) Multiple choice question.

POIs contain information on a specific location. The sights (i.e., POIs with a content) have the following fields: name, GPS coordinates (latitude, longitude), description, pictures (title, image file), voice file. Navigation POIs help users to move along the walk route from sight to sight. They were finalised on the site of the walk. They have the following fields: ID, GPS coordinates (latitude, longitude), navigation instruction (text), voice file.

The content developer team created the script for the walk which was applied to create the digital version of the walk. The walk content development is a complex process which includes multiple steps from defining and clarifying the theme and target audience of the walk, through collecting source materials and creating the walk script until publishing the walk in the IM-prepared app.

5 Evaluation

A questionnaire was created to collect user feedback. It includes 12 product-specific questions. One of them referred to the user's overall satisfaction with the IM-prepared

application. Participants were asked to rate their satisfaction on a scale from 1 (very dissatisfied) to 5 (very satisfied). The results show that 62.9% of participants reported positive satisfaction (rating 4 or 5), while an additional 22.2% selected a neutral rating (3). Only 14.8% of participants reported lower satisfaction (ratings 1 or 2) (see Fig. 6).

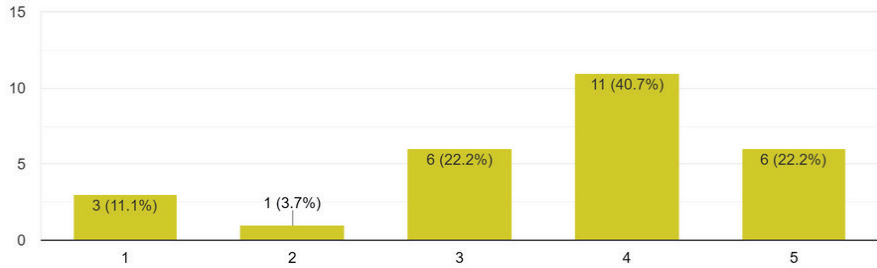


Fig. 6. Participant ratings of overall satisfaction with the IM-Prepared application (Source: Heldal et al., 2026).

Participants were asked whether they would consider using IM-prepared in the future for disaster preparedness, education, or training purposes. Among the 26 respondents, 53.8% indicated “Yes,” 30.8% selected “Maybe,” and 15.4% responded “No.” The majority of positive responses suggest a generally favorable level of acceptance toward future use of the application. The proportion of “Maybe” responses indicates that while users recognize the potential value of IM-prepared, some uncertainty remains, likely linked to the need for further refinement or extended use.

Would you consider using IM-prepared in the future for disaster preparedness, education, or training?
26 responses

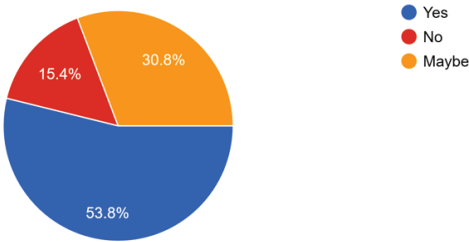


Fig. 7. Participant response on the potential use of the IM-Prepared application in disaster preparedness, education (Source: Heldal et al., 2026).

6 Conclusions

In this paper, we introduced a gamified mobile walk along the Isar river in Munich and reported the joint development efforts of UniBw M and SZTAKI. Although the primary aim of the walk development was to help civilians learn about the preparedness needed

to manage floods, it also presents the cultural, historical and architectural values of Munich bridges. The gamified walk is part of the mobile application IM-prepared. The application was evaluated with the help of a questionnaire. The evaluation result shows that most of the participants were satisfied with the application. Our future plan is to conduct a comparative analysis to evaluate the effectiveness of incorporating games into the walks.

Approaches to flood mitigation have evolved from a focus on structural engineering toward strategies centered on environmental restoration. Traditional methods typically utilize physical barriers such as weirs, levees, and channelization to provide immediate protection by restricting water movement. However, while such interventions offer immediate protection, they can disrupt natural water cycles and increase long-term risks. In contrast, natural flood management emphasizes rehabilitation of a river system's own ability to regulate flow by allowing riverbanks to naturally soak up water (Juan-Diego et al., 2025). This transition is clearly reflected in the historical management of the Isar River following the severe flood of 1899. The bridges constructed after the food represent an engineering approach focused on the structural containment of the river. As current management policies at the Isar and other such rivers favor the removal of artificial constraints to restore more natural riverbanks, these bridges remain to document a specific period of human intervention that preceded modern, integrated environmental solutions. The IM-prepared application offers citizens an accessible way to learn about these historical and environmental backgrounds that have shaped current approaches to flood management.

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