Co-creation of Place-Based Content for Field Trips and Public Trails by Geo-Content Management

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While learning about places in classrooms takes large profit of digital geomedia, digital assisted learning on site is still bound to fragmented solutions, as innovative Extended Reality immersions often demand too much resources to be run on average smartphones. In addition, efforts staging digital aided learning experiences on site are still too cumbersome for regular teaching. In an explorative answer to this challenge, we introduce the FAU Geoexplorer, aiming at focussed presentation of geomedia on site supported by an easy to follow content creation process.

Keywords: location-based services; field-trips; geodidactics

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1 Place-Based Tools to Be Used for On-Site Learning

At present, digitally enriching on-site experiences of field trips is limited to the use of fragmented geomedia and apps supporting learning about specific topics. In contrast, generic e-learning platforms with rich support of the content creation process still support place-based content only to a very limited degree. An integrated combination of both, supporting a broad variety of use cases ranging from field trips to public trails or geo-participation is thus highly relevant.

At the Friedrich-Alexander University Erlangen-Nuremberg (FAU), by developing the FAU Geoexplorer we aim at a tool that acts as an overlay platform integrating both (1) the functionality of pre-existing apps and (2) distributed geomedia from different cloud storage locations and is thus able to support the advantages of a didactically structured content creation process as well as blended learning experiences on site.

In this paper, we first introduce our goals in the context of place-based GIS and provide an overview of the requirements derived from previous research in the field of place-based learning. In a second step, we introduce the main interface of the FAU Geoexplorer and present two examples of outdoor experiences staged with it. We report from early evaluations and conclude with remarks about the road ahead.

2 Starting Point and Goals

Beyond the look for interesting places on behavioural data (like home or work location; see Isaacman et al., 2011), Winter et al. (2009) mark a milestone when Geoinformation Science first asked for an appropriate geo-model of the phenomenological concept of place (first stated by Tuan, 1977; for an

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overview, see Cresswell, 2004). Decomposing the methodological singular of (outside) space rooted in early GIS systems, the concept of place differentiates between the mere *location*, the *locale* of spatial arrangements, and the *senses of place* assigned and modified by ongoing social practices (see also Schatzki, 2002; for an overview, see Kremer, 2018). Following this approach in Geoinformation Science, research invested in supplying platial operators to integrate platial data in spatial analysis (Gao et al., 2013) and in locating places from natural speech (Richter et al., 2012; Vasardani et al., 2013).

At the same time, critical digital geographies (Ash et al., 2018) still call for more substantial *transgressions* in using digital spatial representations as *mode of inquiry* (see also Kremer and Walker, 2022). Reflected by the lowercase plural of *gis* in the sense of *geographical imagination systems* (Bergmann and Lally, 2021), Kwan (2002) first introduced the use of multi-modal data to augment common cartographic representations. Combining place-based modelling and analysis in Geoinformation Science with content analysis of multi-modal data, Kremer (2018) introduced a multi-layer model integrating (1) the analysis of individual motion tracks of tourists with (2) the analysis of tourist photos indicating platial attention and (3) the analysis of interview data making sense of the experiences gathered by (1) and (2). Accordingly, Gao (2022) defines places-based GIS as the combination of (1) platial, multi-modal data and associated sense-making, (2) computational models of place, and (3) related functionality for analysis and visualization.

In this context, but quite in contrast to this analytic approach taken above, the social practice of geo-imaginations (conceptually, see Taylor, 2004) becomes a powerful tool in geo-didactics, when on-site experiences are not only augmented with geomedia but also with tasks demanding creativity (Dickel and Keßler, 2019). Consequently, when teaching GIS in school, Schulze et al. (2015) call for a shift from an *expert view* to an *non-expert use of digital geomedia*. Thus, following the definition of Gao (2022), our goal is not to present enhanced computational models of place – we actually rely on POI representations – but to rather foster both the staging and visiting platial on-site experiences in real space with the use of immersive geomedia and tasks demanding for creative imagination.

On-site learning has been long known to provide deeper insights into place-bound patterns and relations (Feulner and Ohl, 2014; Lude et al., 2013). As a result, place-based approaches to learning are not only used in Geography but also in object-related disciplines like Archeology (Verstegen and Kremer, 2023). At the same time, learning to compare platial patterns across different sites is mandatory to identify similarities and dissimilarities (Arends et al., 2011). Offering a simple place-based application mediating these on-site experiences with the use of geomedia combined with a proper content creation pipeline staging the on-site learning experience thus provides a high potential for enhancing the outcome of on-site learning. This covers imagery, audio, and video, but also 3D content for Extended Reality (XR) when important parts of the site have not been preserved or lack public accessibility. The recent call for climate-neutral travel further increases the demand for field trips arranged with the help of XR content (Mührenberger and Verstegen, 2022; Verstegen et al., 2022).

In response to this demand, we decided to develope a tool supporting mobile location-based learning experiences alone or in small groups. Supporting the content creation process, we provided a separate input form guiding the input process and making content reusable for the needs of different target groups. Our goal in university education is not that students just visit pre-sketched field trips arranged by lecturers. Instead, following the idea of self-organized learning, we taught them how to prepare a field trip in small teams themselves. After mutually visiting the field trips of the other groups, we offered common reflection sessions to discuss the on-site observations amongst the different groups. Because we focus on the co-creation process and on-site presentation of geomedia and do not offer additional geoanalysis, we classify our approach as geo-content management and geo-content delivery, which is in contrast to the concept of mobile Web GIS.

We quickly learned that our approach is also useful in other than just academic settings. The medium-term goal of our project is to provide an application that can be used in academic teaching as well as in school, and to stage public trails from various disciplines. As a proof of concept, in cooperation with the *Metropolregion Nürnberg*, we established digitally assisted public trails in small villages in the region revealing the depth of added value production chains bound to those places. To further support touristic exploration of the trails, we enabled our application for use with QR codes, which will be attached to places in the field and allow for discovering the routes in explorative touristic settings.

3 Setting the Scene: Didactical Considerations

As current approaches are often technology-driven or explorative and lack concepts and evaluations approved by didactics and education sciences (Feulner and Ohl, 2014), we will provide a short introduction on findings in these fields in a first step to then derive related requirements from them (Verstegen and Kremer, 2023).

In contrast to the term place-based learning often used to designate learning about places in the classroom (Aßbichler et al., 2021), we follow the paradigm of mobile, location-based learning to aid learning with mobile devices at a specific place of interest (Feulner and Ohl, 2014). As approaches of self-organized learning (Sembill et al., 2007) lend themselves not only for use in higher education but also in school (Schlieder and Kremer, 2014), the including of students in the co-creation process of setting up a field trip or public trail deepens their understanding of related places. At university, self-organizing can also cover self-scheduled visits alone or in small groups both for identifying suitable places and setting up tasks their fellow students have to solve on site. While mobile, location-based learning provides a high potential for visualizing, contextualizing, and exemplifying on-site content, it poses two challenges: (1) lecturers need special training themselves to stage controlled, yet inspiring and engaging learning experiences (Lude et al., 2013); and (2) reusability is key to compensate for the intense preparation efforts (Feulner and Ohl, 2014).

In an integrated platform, both challenges can be addressed systematically in an integrated manner, as generating, maintaining, and publishing content is a workflow already well supported by learning content management systems (Turnbull et al., 2020). A tool acting as an overlay platform incorporating an easy-to-use workflow model will act as an light-weight content management and content delivery system adapted for the platial domain. It thus reduces both the costs of training students and teachers to compose on-site experiences and increases the reusability of already designed content. In addition, integrating XR content from distributed sources and using functionality from other e-learning apps for on-site assignments further increases the value of mobile place-based learning.

4 Design and Implementation: Geo-Content Management and Geo-Content Delivery

As our platform is designed to guide the content creation process as well as the actual visit, we decided to provide a light-weight solution architecture suitable for different types of media including XR experiences. Designated as overlay tool, it is a design goal to cross-reference and combine other, more specialized apps into a common workflow.

We evaluated a web-based solution as well as native apps on mobile platforms. Native mobile apps usually perform best regarding map frameworks and cached offline content, while web-based solutions allow for a seamless combination with other solutions. After having gathered experiences with a web-based solution for two years now and having identified that a solid offline cache is crucial to be able to offer services also in remote areas without mobile connectivity, we eventually develop a multi-platform solution based on fluttr (Google, 2023) at the moment.

The core ontology of our software (in terms of the core concepts considered; for other usage of the term ontology, see Kremer, 2012) is composed of (1) routes, (2) excursion sites related to specific routes, and (3) pages associated with each excursion site. As digital geomedia can distract from on-site observation, we decomposed the content associated with each site to multiple pages showing one chunk of content at a time. Each page contains a (1) small introducing text, (2) one single piece of media, and (3) a clear task to follow. This step-by-step process reduces the need for special training when working for the first time with the platform – for content creators as well as for visitors. A table of content provides easy access to the input draft at any stage. We currently support a broad range of geomedia including imagery, video, audio, and 3D models, described by appropriate metadata. Content-creation is assisted by a simple markdown editor. Figure 1 provides an impression of the input form.

The presentation layer app is composed of a map that focusses on the current place of interest including a recommended route leading to it and the page-wise visualization of the content associated with the site. The app supports a step-by-step user workflow that guides the visitor along the chosen trail.

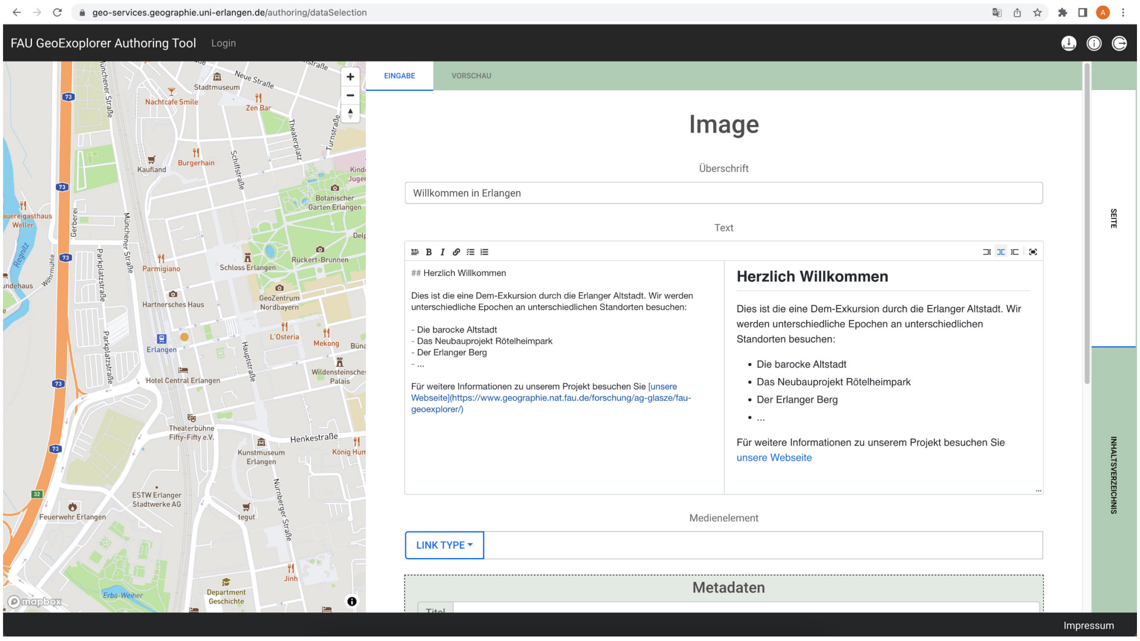


Figure 1: Screenshot of the authoring tool. Example for creating a media page for the content type image partially filled out with markdown content. (Andreas Wagner)

5 Comparing Imagery to On-Site Experiences

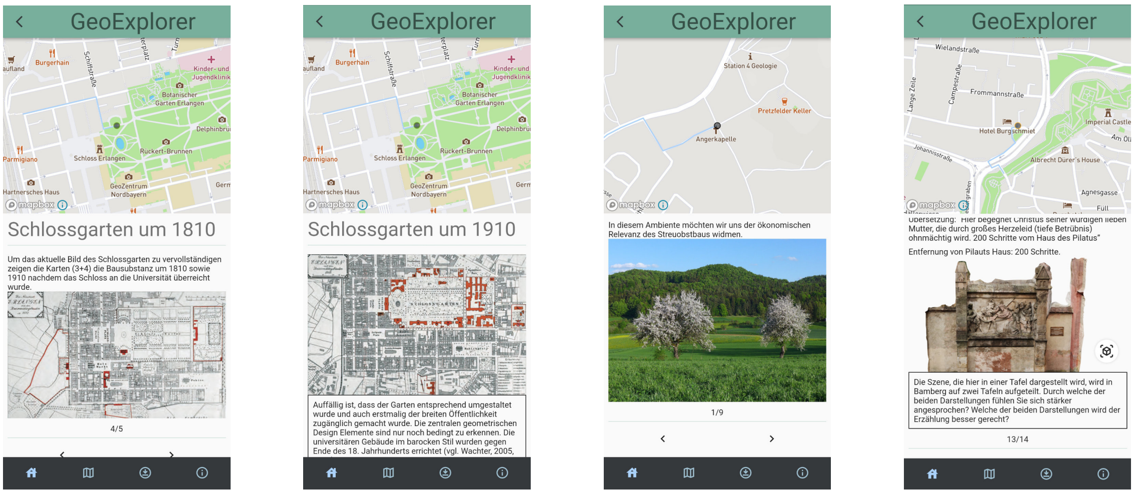
For an illustration of the interface as well as the main use case of our application, we focus on the didactical method of image comparison. Besides historical photographs (Figures 2a and 2b), images can visualize the appearance of specific places during different seasons, or provide the average development of plants for cross-check in heat waves on site. The user could see an image of the cherry blossoom, even if visiting the site in winter (Figure 2c).

This basic method can be further enriched by showing not only images but by also integrating 3D objects. We can briefly illustrate that in the context of Christian Archeology. Stations of the Cross are a series of Christian depictions of Christ carrying the cross from the place of his condemnation in Jerusalem to the place of his crucifixion at Golgota, and finally show the place of his entombment (Sternberg, 2003). The first station of the cross from the world heritage town of Bamberg was digititized by laser scanning and made accessible via the Geoexplorer. This allows for comparison with on-site experiences of a related station of the Cross in Nuremberg and even for projecting similar experieces when no related station was preserved. This experience is augmented best when the 3D object is used to create XR immersions rendering the 3D object on the mobile camera (Figure 2d).

In addition, we offer QR code capability to support entering a public trail on site. Basic information presented on pyhsical information boards in public can be digitally enriched by geomedia and nested into a trail containing other places without physical boards. Following the QR code, tourists are shown the site-specific content in the context of the whole trail and can decide to follow the trail from this point or even walk to the starting point to follow the complete trail.

6 Early Evaluation Results and Road Ahead

First qualitative feedback using the FAU GeoExplorer (Kremer, 2022) pointed at the positive effects of mobile, location-based learning. Students very much liked to go out in the field according to their own schedule and explore places to be represented on our platform. When acting as co-creators, students appreciated most the high motivation gained from working with digital tools in an explorative creation process. Well-known limitations cover the extra effort needed to prepare on-site learning experiences (Lude et al., 2013), which is balanced by increased reusability of content. Other impedi-



(a) Image comparison with a map from 1810

(b) Image comparison with a map from 1910

(c) Image for comparison of a landscape in spring

(d) 3D object with possibility to view in AR

Figure 2: Screenshots from FAU Geoexplorer

ments cover limitations of mobile devices in general, like readability of displays in bright sunshine, low battery runtimes, lack of mobile connectivity in remote areas, and data privacy issues (Feulner, 2021).

After our current work to provide the FAU Geoexplorer as a native app for mobile platforms, we will focus on native integration of simple e-learning tasks and add further support of more detailed geo-visualizations on the map. On top of that we like to support more explorative work with 3D objects, e.g., linked with 360° image spheres. As we are able to attract more and more project partners, we plan to conduct more formal evaluations.

Author Contributions

D Kremer contributed the main idea. A Wagner contributed the details about the technical implementation.

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