Heritage education projects by university students for pupils: Digital and data-driven learning in a humanities teaching-learning lab.

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Abstract

Hitherto, digital humanities education approaches have primarily been aimed at students. This paper examines educational programmes for students to teach cultural heritage to pupils. Based on a classification in European framework programmes, concrete practical examples from a digital history teaching and learning laboratory are presented. Suitable digital tools for researching and documenting cultural heritage are introduced, and the possibilities and limitations of data-driven learning with children and young people are reflected upon. Initial results show that, in addition to only rudimentary digital and information-related skills, pupils also have limited knowledge of the processes and requirements associated with the collection, processing and use of data. However, the competent handling of data is of great importance for the evaluation of historical artefacts and events. With support and in an interactive way, these skills can also be taught to younger pupils.

1. Introduction

Cultural heritage education and the teaching of digital and data-related skills are considered pivotal areas of development, not only in university education, but also in school education. However, they are insufficiently anchored in the curriculum, especially in the field of historical humanities, and are only supported by selective offerings (Münster S. et al., 2021).

Due to their interactive and interdisciplinary settings, extracurricular educational institutions such as student laboratories are particularly suitable for a multi-perspective and digitally supported examination of data (Itzek-Greulich, et al., 2016). School laboratories with a digital focus in German-speaking countries have so far been almost exclusively within the STEM field. Although some laboratories focus on the social sciences and humanities, there has been little digital engagement with historical data by pupils to date (Münster D., Münster S. and Dietz, 2023).

As an extracurricular teaching format for digital, cross-learning-phase education with a focus on cultural heritage and history, the Digital History Teaching and Learning Laboratory (DHLabor) has been set up as a project at Friedrich Schiller University in Jena since 2022. Here, students from various disciplines are trained as tutors who design and test courses for pupils and make their teaching concepts available to other educators.

The aim of this article is to (a) classify it within European framework programmes, (b) present the approach of the Jena Teaching and Learning Laboratory and the initial results of pupil participation in student projects for the digital research and documentation of cultural heritage, and (c) reflect on the possibilities and limitations of processing and presenting historical data with digital tools by pupils.

2. European framework programmes for digital heritage education

The European Digital Competence Framework (DigComp) (European Commission, 2022) discusses digital competences as key competences for citizens in everyday life. Frameworks with recommendations for teachers include the European Framework for the Digital Competence of Teachers (DigCompEdu) (European Commission, 2017a) and the Global Framework for Digital Competence (UNESCO, 2018), the latter of which is aimed at university lecturers in English-speaking countries and covers media literacy, communication and collaboration, learning skills and information literacy, among other things.

In addition, the European Cultural Heritage Strategy for the 21st Century (European Commission, 2017b) calls for the integration of cultural heritage education into school curricula. The objectives are to impart knowledge, for example about the historical background of cultural heritage, to raise awareness of its value for today's society, and to demonstrate and to test practical ways of recording and documenting it. The knowledge and digital skills of teachers are crucial to the success of cultural heritage education, as the diverse levels of meaning of cultural heritage can best be explored through interactive methods (Münster S. et al., 2021).

3. The involvement of pupils in digital heritage projects by university students

3.1 Digital cultural heritage

Digital cultural heritage is an emerging field worldwide. Cultural heritage refers to traces and expressions of the past that have lasting value in today's society (UNESCO, 1989). Traditionally, it has focused on material objects, but a broader understanding that also includes intangible heritage and computer-based material has gained importance over the last decade. Digital

heritage, which is technically intangible, encompasses resources of human knowledge or expression (e.g. cultural, educational, scientific) as well as cultural heritage materials, including digitally created or digitised texts or images (UNESCO, 2003).

3.2 The Jena Teaching and Learning Laboratory

In order to explore the possibilities and limitations of involving pupils in digital humanities projects centred on cultural heritage, Friedrich Schiller University in Jena has set up the DHLabor, where students from various disciplines are trained as tutors and design, deliver and evaluate courses for pupils (Fig. 1). The aims of the laboratory are to enable prospective educators to develop, test and reflect on their own digitally supported teaching programmes on historical topics and to enable school pupils to engage with history and cultural heritage from multiple perspectives using digital tools. This strengthens the digital and data literacy of students and pupils, and evaluates as well as promotes the use of digital working techniques for researching, preparing and presenting historical topics.

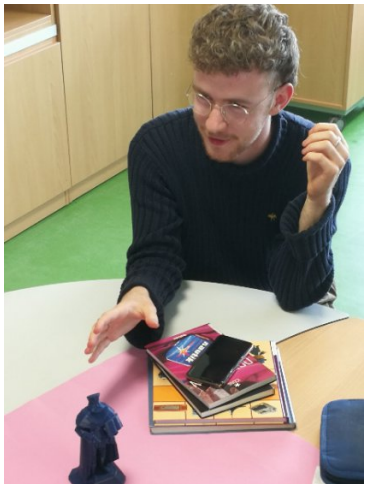

Figure 1. Student tutor at the DHLab.

To date, 12 courses have been held in 8 local schools and leisure centres by 15 students from the fields of art history, film studies, history, political science, German studies, German classics, sociology, computer science and teaching. Around 130 pupils aged between 7 and 16 have taken part in the courses so far, most of which take place outside of school hours, for example as an afternoon leisure activity at school, a holiday workshop at a youth centre or in the laboratory facilities of the professorship.

The thematic focus of the teaching and learning lab has so far been on the history of the city of Jena and is intended to motivate children and young people to engage creatively with the cultural heritage, personalities and historical events of their hometown based on primary sources. To this end, various digital methods such as web-based source research, the creation of 3D models and the handling of oral history interviews were taught, and digital skills in dealing with social media posts and AI-generated content were promoted.

Selected pupil results and research data, such as 3D models, photographs and text-image descriptions of historical objects or monuments, will be made visible in the long term as points of interest in a globally accessible 4D viewer or fed into European data pipelines. The teaching concepts and materials will also be made available to other teachers on public platforms.

3.3 Project for the digital cataloguing of decentralised monuments

As part of the course ‘Rethinking Remembrance Culture – Digitising *Stolpersteine* in Jena,’ memorial stones for the victims of the Holocaust are visited and photographed (Fig. 2). For the students, this provides an initial introduction to the discussion about cultural memory and encourages research into the historical background of the crimes of the Nazi regime. Information about the lives of those who died and are commemorated by the *Stolpersteine* is researched and short biographies are written. These are made available to the public on a website specialising in *Stolpersteine* or as points of interest in a 4D viewer.

Figure 2. *Stolpersteine* of Hermann and Klara Friedmann at Grietgasse 25/26, Jena.

3.4 Project for the 3D digitisation of historical everyday objects

In the course titled ‘Objects telling (his)stories’, everyday historical objects from the immediate surroundings, such as old kitchen utensils, appliances, tools, or historical toys from their immediate surroundings, ask their parents and grandparents how these objects were used in the past, and listen to the personal stories associated with them. Using various analogue and digital methods, such as drawings, photographs and 3D scans, they document these personal testimonies of the past to be preserved for the future (Fig. 3). The aim is to gain a basic understanding of how historical sources are created and which methods of data collection and documentation can be used.

Figure 3. Methods of digital data collection and documentation using the example of historical everyday objects.

3.5 Project to design a virtual museum

The course ‘Museum of the Future’ aims to raise awareness of the difference between sources and their presentation, and thus of the constructive nature of history. On the one hand, during a visit to the city museum, pupils learn about the tasks of a museum, such as collecting, researching, preserving, exhibiting and communicating, and create their own pocket museum in the form of a matchbox containing small, personally significant objects.

On the other hand, the pupils in the course take on the role of a museum curator and independently follow the path of historical research from the finds to the reconstruction to the presentation (Thüringer Ministerium für Bildung, Jugend und Sport, 2021). Embedded in a story, the pupils are to fulfil assignments for a museum of the future as time travellers, and document and display their present as detailed as possible. They accomplish this by digitising objects from their everyday lives, such as keyboards, smartphones, running shoes and erasers, in 3D (Fig. 4) and creating profiles with information on their background and usage scenarios. In doing so, the pupils research, when and by whom the objects were invented and what materials they were made of.

They then create photo collages with researched and self-made images and present them to the group during a gallery tour on tablets distributed throughout the room. In the process, the pupils are made aware of issues such as copyright and the need to cite sources.

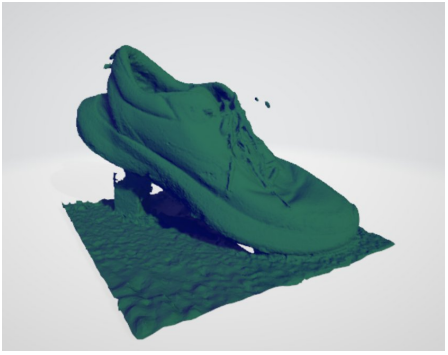

Figure 4. 3D scan of an everyday object for a virtual museum.

3.6 Project on learning history with Instagram

The course ‘Learning History with Instagram’ deals with the subjectivity of historical narrative and the search for and presentation of reliable information on the Internet.

Under guidance, pupils research the biographies and social contributions of historical or deceased figures they have chosen themselves, select relevant information and appealing images, write texts tailored to their target audience, and explore the specifics of the Instagram post format (Fig. 5).

During the process, they are made aware of the need to critically question content on the Internet, especially on social media platforms, and are made aware of issues such as data security, fake news and deep fakes.

Figure 5. Instagram posts about deceased or historical figures.

3.7 Project to design a virtual city

The course ‘This is our city!’ deals with topics such as urban space, participation and appreciation of local historical figures. Younger pupils in particular search for clues in their surroundings, photograph places, research the background of street names, create profiles and design their own ‘children's city’. In doing so, they collect ideas about what a city should look like according to their ideas and how squares and streets could be named. They record the results creatively in the form of a fictional city map on an interactive whiteboard (Fig. 6).

With the help of age-appropriate search engines, the pupils learn how to find relevant information on the Internet, summarise and process it into new texts.

Figure 6. Map design of a virtual city created by children.

3.8 Project for 3D modelling of historical cityscapes in Minecraft

The course ‘JenaCraft – The City of the Future’ focuses on cities, urban space and the realisation of pupils' own ideas. Here, students explore sustainable and needs-oriented design of city centres. They examine a selection of public spaces and historical buildings they are familiar with and create their own 3D models. Minecraft is used as the learning environment, based on the concept of gamified learning (Hancel, 2016). As an open-ended, real-time video game, it allows pupils to formulate their own learning goals and, in addition to a motivating gaming experience, enables them to implement their own ideas in a self-directed manner (Christians, 2020). The data is based on on-site inspections, photographs, Google Earth images and coordinates. The historical buildings, such as St. Michael's Church and the

Johannistor, are not only reconstructed as accurately as possible, but also expanded with additional elements that use natural resources, such as solar panels, rainwater collection basins and green spaces (Figs. 7-9).

The processes and requirements of collecting, processing and presenting historical data are reproduced here in a digital game environment. The video game Minecraft offers the opportunity to practically trace the path from the original source to the 3D model. One challenge is the limited tools available in the video game for true-to-scale and detailed modelling of the objects to be represented. The resulting simplification requires joint, ongoing reflection with the course instructor and, for example, a checklist of quality criteria, and mandatory and optional elements for the reconstruction, which is created jointly in advance.

Figures 7-9. 3D models of St Michael's Church in Jena.

4. Possibilities and limitations of data-based learning with pupils

4.1 Qualitative surveys of students on digital and information literacy

One gap that has been empirically proven in the DHLabor is the lack of competence among schoolchildren in assessing the quality of data and digital information (Hopf, 2024).

In six courses conducted by students between May 2023 and July 2024 in schools and leisure facilities in Jena, a total of 43 pupils aged 8 and 16 were surveyed twice on topics related to the DigComp framework, such as online safety, information and data literacy, and the use of digital tools. The aim was to find out what prior knowledge and digital skills the pupils had and how these changed as a result of attending the student courses. The data collected served as a basis for further course planning by the students.

Initial results from the surveys suggest that teaching digital skills to younger age groups is possible to a certain extent, albeit in a playful manner and with the support of student tutors. Awareness of internet safety varied across all age groups, but knowledge of specific secure websites and search engines was lacking almost across the board. According to the participants' individual assessments, the ability to find relevant and reliable information on the internet was also rather low in all age groups. However, it increased comparatively with increasing age and experience (Fig. 10).

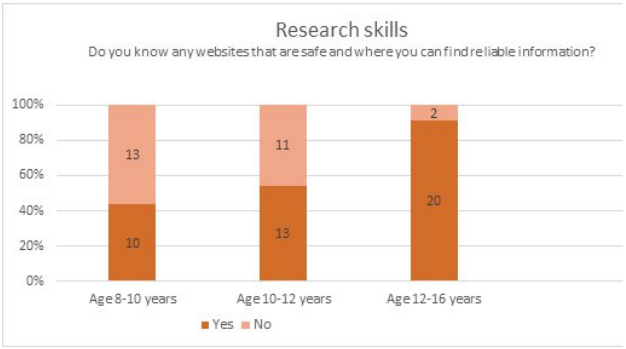

Figure 10. Example of survey results on individual ability to find reliable information on the Internet.

The informational value of the survey is primarily limited by the small number of participants and the different questions, which varied depending on age group and course topic, particularly in terms of format and presentation. (Münster D., Münster S., Dietz, 2025).

4.2 Challenges and initial approaches to the digital examination of historical data by pupils

In addition to only rudimentary digital and information literacy skills, the pupils were found to have only limited knowledge of the processes and requirements involved in collecting, processing and using data.

However, the competent handling of data such as 3D models, which are a tangible example of multimodal research data due to the necessary documentation of meta and paradata, is highly relevant for the evaluation of historical artefacts and events.

The presentation of historical data, whether in 3D models, images, computer games or museums, can strongly influence the perception of history. However, as it is often based on hypotheses

and fragmentary sources, it requires a critical, reflective and informed approach to digital information and tools, as well as an understanding of the reconstruction of history (Münster, 2022).

Against the backdrop of social debates on fake news and disinformation, the courses offered by the Teaching and Learning Lab provide an opportunity to promote students' understanding of how to deal with historical data. In doing so, they fulfil a social mandate.

In the courses offered by the Teaching and Learning Lab, pupils are introduced to the collection, processing and use of research data through creative and exploratory engagement with topics and artefacts from their everyday lives. Their awareness is raised and they are trained to handle data competently.

While the thematic focus of the DHLab courses has previously been on regional history, the range of topics is now being expanded to include new aspects such as environmental impacts on architectural heritage, opportunities for independent participation in its preservation, and the development of ideas for sustainable and user-friendly urban development.

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