

Citizen science in archaeology: an interdisciplinary approach to uncover prehistory

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Three projects are presented in the light of citizen science and archaeology, each in their own way involving volunteers with an ambitious scientific and dissemination agenda. All three projects have an interdisciplinary approach and emphasize involvement and co-creation with participants in the development process. Additionally, we consider opportunities and challenges in citizen science with respect to interdisciplinary projects in general as well as specifically in archaeology. The perspective for future citizen science projects in archaeology and in other interdisciplinary contexts are discussed.

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1. Introduction

The subject of archaeology is located in the faculty of humanities but works closely with the natural sciences and draws on a number of disciplines such as anthropology, history, sociology, geology, biology, physics and chemistry.

In Denmark, we have a tradition of strong local involvement of volunteers in archaeological work both in excavations and at museums, in the departments of collections, conservation and dissemination. The archaeological area is therefore ideal for new projects that seek to convey an interdisciplinary, application-oriented approach to the creation of knowledge, and at the same time exploit the enormous potential of the many archaeological finds that are uncovered across the country every year.

2. Aim

Through the presentation of three recent projects, each in their own way involving volunteers with an ambitious scientific and dissemination agenda, we focus on citizen science in archaeology. All three projects work with an interdisciplinary approach and emphasize involvement and co-creation with participants in the development process.

We consider opportunities and challenges in citizen science in interdisciplinary projects in general and in archaeology in specific. We thus aim to discuss the approach of different scientific traditions to citizen science and the perspective for future citizen science projects in archaeology and in other interdisciplinary contexts.

3. Three different project examples

3.1 DIME - Digital metal detector finds

Every year, volunteer metal detector users find thousands of objects of great cultural-historical significance in Danish fields. They continuously contribute to the emergence of some of the most startling finds in Danish archaeology, and the metal detector finds have revolutionized our understanding of the prehistoric and historical societies from the Bronze Age to recent times.

Digital Metal Detector Finds (DIME) has been developed with the aim of enabling optimal utilization of the large dissemination and research potential of metal detector finds [1]. Furthermore the aim is to increase public availability of archaeological finds, increase the collaboration between amateur archaeologists and local museums, allow amateur archaeologists to gain qualifications, and serve as an international best practice example of co-creation and citizen science in archaeology.

The DIME project was developed in 2016–2018 by a group of museum professionals and university archaeologists in close collaboration with detector users and a broad panel of professionals from museums across the country. The platform and database is used by over 3.000 amateur archaeologists and the project collaborates with 30 archaeological museums in Denmark, including the National Museum and Faroe Islands National Museum (Tjodsavid). Beyond functioning as a registration tool, the database serves as a digital collection of presently 161.000 finds.

Read more about the project: www.metaldetektorfund.dk.

3.2 The Archaeological Workshop - *Archaeology and Natural Science: science teaching and cultural history*

In the project *Archaeology and Natural Science: science teaching and cultural history*, the Museum of Copenhagen collaborates with teachers and students in elementary school to develop new methods in science teaching.

The purpose of the project is to explore the potential of working with archaeology and natural science in 7th and 8th grade in elementary school to strengthen the students' STEM competencies and their scientific, general and democratic formation, by involving them in professional archaeological and scientific work at the museum. The students work hands-on with authentic archaeological material, and use scientific archaeological methods alongside the museum's professional archaeologists. As part of the project, the museum has developed a new Archaeological Workshop that forms the framework for both the project's teaching and the ongoing post-excavation work of the archaeologists. As such, the students also work in an authentic scientific setting. Students gain direct experience with interdisciplinary work between archaeology and natural science, and they participate in the creation of new knowledge in the museum's archaeological work.

Archaeology and Natural Science: science teaching and cultural history began in 2020 and will run for a total of four years. The project is supported by the Novo Nordisk Foundation. The goal of the project is to have had, by the end of the project, a couple of thousand students participate in courses in the museum's Archaeological Workshop and for these students to have contributed to the development of the courses.

The project is divided into three subprojects: 1) development, implementation, and evaluation of a number of courses in collaboration with two partnership schools, including both teachers and students; 2) establishment of the Archaeological Workshop at the museum, which will function as a platform for the project-related teaching and future teaching; and 3) development and recording of digital educational films in various formats. Therefore, the goal is that when the project period has expired, we will have created a reliable teaching environment with the establishment of the Archaeological Workshop, and we will have developed a well-proven and sustainable teaching format with associated digital teaching material, all with the purpose that students at all levels in elementary school can be educated in archaeology and natural science at the Museum of Copenhagen.

Read more about the project: www.cphmuseum.kk.dk.

3.3 Next Generation Lab

In the project Next Generation Lab, high school students determine the species origin of original, organic archaeological material using cutting-edge methods in protein chemistry. The project is developed in a close collaboration that involves teachers and students, university researchers with multi-disciplinary backgrounds, and the local museums delivering the archaeological material. In the interdisciplinary laboratory course for high school classes, the students experience a full day in the laboratories at the Natural History Museum of Denmark, where they work in close proximity with researchers at the University of Copenhagen [2].

During their experience in the Next Generation Lab, they undertake several analyses, from protein-based and morphological species identification, to interpreting mass spectrometry data, and discussing their implications for our understanding of different aspects of society in medieval Denmark. The students learn and apply complex analytical techniques, such as peptide mass fingerprinting (also known as ZooMS—Zooarchaeology by Mass Spectrometry [3]), to large numbers of morphologically non-diagnostic bone and leather fragments. By doing so, they expand our archaeological knowledge of animal exploitation and study materials that are rarely prioritized in medieval assemblages, but which have already been shown to be able to provide unique evidence of a city's use of animal resources. The students' own work in the lab generates data that are used by the university researchers for scientific purposes, such as peer-reviewed publications and presentations at international conferences, and the high school itself helps to deliver new knowledge about life in the medieval towns back to the local museums, which have contributed the archaeological material.

Next Generation Lab started in 2021 and will run for a total of four years. It is supported by the Novo Nordisk Foundation. Within the first year, more than 600 students have participated. In total, the project will have more than 3.000 students experiencing the full day course, i.e., special tailor made courses for students who have a specific interest in working with authentic data and other teaching materials, such as videos targeting high schools.

The outcomes of the project are twofold: the origin and species of animals from a large amount of previously not prioritized archaeological material are identified; and high school students are trained in the scientific process, and cutting-edge methods in the laboratory, while they experience what it is like to be part of a real research project.

The project has already published the first results based on student generated data [4]. By inviting the public to participate in archaeological research, the project's first 52 samples, including both recognisable and unidentifiable objects, were thus analyzed. In the study, we show that the participants not only generated good data, but also contributed to current knowledge by identifying two hitherto undescribed animal species used for leather in medieval and Renaissance Copenhagen, namely horse and deer.

Read more about the project: www.nextgenlab.dk.

4. Opportunities, challenges and future perspectives

All the material that the students work with in the development of the projects at the Museum of Copenhagen, and also at the Natural History Museum of Denmark, are real archaeological finds collected from the excavations, but subsequently not prioritized for further analysis. And so, we are given the opportunity, via the students, to examine archaeological material that would otherwise not have been examined.

The fact that the students are working with authentic archaeological material leads them to be more motivated and involved in the courses than they would have been otherwise. Archaeological finds have an instant fascination and a great strength in that they are physically available due to their materiality. The authentic perspective the students get in working with real archaeological finds and real scientific methods, in authentic research settings alongside professional museum staff and researchers, are essential elements in the projects. Thereby, the students take the courses and the projects seriously, and our experience is that these elements are a

great motivator for the participants' level of commitment in taking part in our archaeological citizen science projects. To actually be part of creating an understanding of your own history makes it much easier to connect to the past, and it also creates an understanding of how theory is used in practice.

Achaological finds are in nature precious, irreplaceable, and often fragile, and one might think that these very facts could be a challenge in connecting students to working with archaeological finds. But it has been our experience that the fact that the students were able to work with authentic finds from archaeological excavations meant that they became particularly involved. The students understand the importance of being careful in working with archaeological material, and they understand the risks of losing important data if they are not handling it accordingly.

Another challenge in working with citizen science in archaeology in Denmark is the structural, legal boundaries of excavations led and financed by public or private client organisation. According to Danish law ("Museumsloven, Kapitel 8") museums are responsible for excavating and examining archaeological finds. It is thus a subject for further discussion and debate regarding how we can democratize this process, involve the public, and still fulfill the legal and financial obligations museums have towards public or private client organisation, whose main interest are cost efficient excavations..

Although the projects are still under development, we already see a potential for citizen science based archaeology. By inviting teachers and students in as part of the development process, we are inspired to ask questions that researchers and museum professionals might not otherwise ask. These questions may seem odd, at first, but they can sometimes lead to discoveries that might otherwise have been overlooked.

Building on the foundation and knowledge gained from the above projects, we hope to be able to think of and develop other interdisciplinary approaches in citizen science, both in archaeology and other fields. This approach could also perhaps be extended to other parts of museum work, for instance within conservation of modern collections.

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