
Perspectives on Co-production of Knowledge in Fieldwork Experience for 3D Preservation of Indigenous Heritage

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In June 2024, a team of researchers and research collaborators visited the Milwaukee Public Museum (MPM) and Dartmouth College's Hood Museum of Art (Hood) to digitize Alaska Native heritage pieces from the Kawerak region. The research team for the National Science Foundation (NSF)-funded project CAREER: *Three-Dimensional Modeling and Digital Repatriation of Arctic Indigenous Heritage in the Bering Strait Region of Alaska* (#2327574) comprised six research assistants from the University of Missouri, alongside the principal investigator, a doctoral student from the University of Alaska Fairbanks, collaborators from the University of South Florida and Kawerak Inc., the Tribal nonprofit consortium of 20 federally recognized Tribes. Their objective was to 3D model and 2D photograph the Kawerak region collections. The Kawerak region, located in western Alaska, encompasses the approximate area from the village of Stebbins in the south, to the village of Shishmaref in the north, including the Bering Strait, most of the Seward Peninsula, and the islands of the northern Bering Sea. Before and during fieldwork, the research team consulted with nine Knowledge Holders via Zoom to understand what types of heritage pieces community members would be interested in digitizing (see figure 1).

The larger goal of the project was to understand Indigenous communities' perspectives on using 3D technologies to preserve and perpetuate their ancestral heritage. This project actively contributes to knowledge repatriation, understood as an origin community's reassertion of rights over their own knowledges (Csoba DeHass et al. 2025). Through knowledge repatriation, Tribes gain information that helps them in pursuing future physical repatriation claims according to their own heritage management priorities.

We used the 3D technologies of photogrammetry and structured light scanning. Photogrammetry is the process of recording and combining a series of 2D photographs to create a 3D model. Structured light scanning emits light to record an object's geometric surface. Both technologies have advantages and disadvantages and using them in tandem often yields the most accurate models. We also used culturally responsive 2D photography. Whereas conventional museum photography processes result in a few photos of the piece with limited angles, culturally responsive photography is a process of 2D photography that requires engaging with details of interest to communities. The digital documentation of sealskin sewing by recording an Elder Inuit seamstress's skilled maneuvers of folding and stitching has been described by Nancy Wachowich (2018) as a form of culturally responsive knowledge transmission. Similarly, in our 2D documentation, we chose to focus on details that would be important for Alaska Native artists to know for replicating the process when making similar items. For example, we photographed where stitches were attached, and where light would shine through a hole carved into a heritage piece.





Figure 1. Map of Kawerak region villages. Map created by Lily McEwen, 2025.

Our Research Frameworks

We employ the Co-production of Knowledge Framework (CPK), which bridges different knowledge systems to responsibly work together on a shared project (Ellam Yua et al. 2022). In our case, CPK facilitates bringing together Indigenous and researcher voices to create a synergy of thought and purpose through the research process. Often, communication styles used in scientific research differ from Indigenous communication styles. It is important for researchers to develop an understanding of these cultural differences so they can more effectively communicate (Ellam Yua et al. 2022). Ongoing and sustained communication builds trust and educates early-career scholars on how to respectfully work with Indigenous communities.

This project also applies the Indigenous Data Governance (IDG) framework. IDG is the authority of Indigenous peoples and Tribal Nations to govern how their data is managed and used (Carroll, Rodriguez-Lonebear et al. 2019; Carroll, Garba et al. 2020). Key components include regaining and maintaining Indigenous ownership, exercising rights regarding access, use and stewardship of data, as well as ensuring fair relationships between communities and researchers (Carroll, Rodriguez-Lonebear et al. 2019; Carroll, Garba et al. 2020). In applying the IDG and CPK frameworks, our collaboration has included Alaska Native partners, museum professionals, and university staff and students.

Fieldwork Perspectives

This report was co-authored by an undergraduate and a graduate research assistant who facilitated discussions with their fellow research assistants, principal investigator (PI), and Tribal collaborators. As such,

this article reflects the synergized co-production of research through co-authorship as reflected in our negotiations of article content, structure, and contributions. The report is written from three perspectives: the mentoring and public programming perspective, the Tribal collaborators' perspective, and the student research assistants' perspective. These perspectives provide a holistic understanding of how each group conceptualized the museum fieldwork and why this research and learning experience was impactful for each group. The student perspective includes student reflections on the preparation, during fieldwork, and post-fieldwork.

Mentoring and Public Programming Perspective

This section is co-authored by project PI (Csoba DeHass) and a doctoral student on the project who is also a museum professional (Taitt). We chose to reflect on the challenges of balancing mentoring student research assistants (RAs) while also completing the project's fieldwork goals.

In decolonizing methodologies, the focus is often on developing new projects that create ethical collaborations between Indigenous communities and researchers. This requires comprehensive training in respectfully working with Indigenous knowledge systems and Native Nations (Ellam Yua et al. 2022). Similarly, communicating to the public the significance of project co-design with Indigenous communities and the changing nature of practicing team science underpins museum programming. Museums embrace the belief that people of all ages, experiences, and backgrounds can meaningfully contribute to educational programs. This approach enriches visitor experiences, museum collections, and the broader community. When engaging in a research project in which Knowledge Holders are paired with early-career researchers, a community of trust and mutual understanding forms. This exemplifies best practices in museum education and results in mutual expertise exchange and a shared learning process.

High impact educational practices (HIPs) focus on providing learners with experiential opportunities that facilitate long-term, intentional, and engaged learning through firsthand engagement, analysis, and reflection (Fischer et al. 2021). Learning community and undergraduate research are two of the original 10 HIPs that positively impact student success (Kuh 2008) and facilitate deep learning (Kuh 2013). To maximize the benefits of HIPs, faculty mentors and student learners actively and intentionally co-create the learning experience to include well-designed support, appropriate levels of expectations, and opportunities for integration through reflections (Kuh 2013). In preparing for the fieldwork, student RAs completed training in research compliance, the use of 3D technologies and ethnographic methods and information learned about the communities of the Kawerak region. To create opportunities for understanding the complexities of fieldwork-related decision-making, the RAs participated in articulating research developments, troubleshooting challenges, and trip planning.

Non-hierarchical research relationships between Knowledge Holders, researchers, and students foster knowledge and expertise sharing at all levels (Phillips 2022). Learning communities expand perspectives through the synergy of co-production and create places of innovation that introduce new ideas to researchers and institutions.

Creating opportunities for reflection during fieldwork prompted RAs to recognize their own skills and expertise contributed to the shared project goals in context, such as their extensive work recording data for 3D models. Having unique access to the museum as a fieldwork site gave students insider perspectives, allowing them to engage with the collection in a more holistic way. From an educational perspective, this deepened the RAs' understanding of the museum collections, the origin communities, and the stewardship of knowledge and cultural heritage praxis.

Community-engaged courses and project-based learning provide undergraduate students with experiential opportunities that develop direct and transferable skills. (e.g., Maxwell et al. 2025). Their benefits to enhanced learning and student career development are clear, but the course format limits the potential for further development beyond the semester. It also creates an instructor-learner dynamic that is difficult to deconstruct as the learners gain skills.

Using the same community-engaged principles in conjunction with HIPs, learning communities and undergraduate research, support early-career researchers to participate as equal collaborators. Further, it

creates an opportunity to train the next generation of scientists skilled at ethically working with Indigenous communities while valuing a comprehensive scientific approach. Incorporating undergraduate researchers into active project teams also broadens social networking and the opportunity for community mentoring (Kobulnicky and Dale 2016), both of which foster a sense of belonging in science and cultivate a skilled scientific workforce.

Tribal Collaborators' Perspective

This section is co-authored by Kawerak Inc., Social Science Program Director (Raymond-Yakoubian) and Program Manager (Ellanna [King Island]) and details how the project came to be and the importance of this research from Kawerak's perspective.

Many Tribes have expressed wariness and reluctance toward research carried out by non-Tribal members, with good reason. Some archaeologists and anthropologists have done research that has harmed the Tribal communities in which they conducted studies. The theft of human remains—often from graves—sacred belongings, and cultural pieces has led to many of these ancestors and pieces being housed in museums distant from Tribal communities (Dungca et al. 2023). The Kawerak Social Science Program's efforts in fostering partnerships and co-creating knowledge with Tribal communities have significantly contributed to protecting communities from potential exploitation. In evaluating any project, it is key to consider whether the research aligns with the communities' interests and capacity to facilitate the development of meaningful partnerships. This project was co-designed to help chart the path for respectful engagement in research and to eliminate potential barriers to participation.

The initial reaction to the project from community members was a mix of frustration and confusion. At first, community members believed the research team intended to travel to museum collections to simply photograph Kawerak region heritage pieces. However, Kawerak's engagements with the Tribes fostered deeper conversations, leading to a shared understanding of the project's purpose.

Kawerak emailed all twenty Tribes a "Dear Tribal Leader" letter that formally introduced the project. Tribal administrators then worked with their Tribal councils to identify potential participants to represent their Tribes. Kawerak staff prioritized transparency to build trust and meaningful collaboration. As the project advanced, the Knowledge Holders learned more about the collections and grew into their role as project leaders. They understood that the research team depended on their input and guidance, which were crucial in shaping the project's direction and outcomes. Knowledge Holders shared their reflections on the heritage pieces' cultural significance and the stories they embody. They also emphasized the importance of nonhuman relatives in the context of cultural heritage, reinforcing that heritage pieces are not isolated items but rather integral components of the broader knowledge system.

The project is important to Kawerak, Inc., Kawerak region Tribal governments, and Tribal members of the Kawerak region. It provides the opportunity to re-establish connections with cultural heritage in ways that are meaningful to Tribes (Kawerak, Inc. et al. 2024) and that had been taken from the Kawerak region. The project also emphasizes Tribal sovereignty and Indigenous Data Governance. A primary objective is to leverage technology and available resources to return the knowledge imbued within heritage pieces to facilitate future Tribal decisions, including pursuing physical repatriation. By integrating Indigenous perspectives into the discourse on ethical and respectful conduct of research with Tribal Nations, the project is actively transforming the conversation of ethical and respectful research with Indigenous communities. Tribal voices must be included at all stages of research to ensure that Tribal Nations govern the stewardship of the data originating from their communities (Ellam Yua et al. 2022).

Students' Perspectives

Abigail (graduate), Addison (sophomore), Brennan (senior), Lily (graduate), and Peyton (junior) participated in this fieldwork experience as research assistants. Our reflections are streamlined into the student perspective narrative. We chose to engage in this reflection because, as Veronica Denison and colleagues

(2021) explain, when students face real-life technical challenges during museum fieldwork, they come to see fieldwork as an ongoing process. This shift in perspective helps them develop a stronger sense of professionalism.

Pre-Fieldwork Preparation

In preparation for the fieldwork, research assistants assembled databases from the MPM and the Hood's online collections and documentation provided by the museums. These databases included information on the types of cultural heritage pieces, the origin communities, and notes on material type and dimensions.

During the early planning stages, our PI gave us insights into communication with collaborators at Kawerak, Inc. and with both museums. Student research assistants completed research preparation including Institutional Review Board certification, ethnographic interview training, and hands-on 3D modeling practice. In April 2024, the research team hosted a hybrid workshop with Kawerak Inc., Knowledge Holders, and museum staff to familiarize the team with each museums' collection prior to the fieldwork. At each museum, the research team presented the collection pieces and made notes of the pieces Knowledge Holders expressed interest in having 3D modeled.

During Fieldwork

Our first week of fieldwork was at the MPM, a natural history museum featuring global geology, zoology, botany, history, and anthropology collections (Milwaukee Public Museum n.d.). Most of the Kawerak collection contains archaeological cultural heritage pieces such as hunting and fishing equipment, with some ethnographic pieces such as mukluks, gut parkas, and baskets. We 3D-documented 88 pieces and took culturally responsive 2D photographs of 450 pieces. In addition, student researchers prepared and taught a hands-on 3D training workshop for MPM staff. Our second week of fieldwork was spent in Hanover, New Hampshire, at the Hood, which has extensive collections of contemporary and historic global arts (Hood Museum of Art n.d.). We 3D-documented 54 pieces using photogrammetry and structured light scanning and took culturally responsive 2D photographs of all 169 Kawerak pieces.

Both museums we visited care for large Kawerak collections and expressed interest in working with us through the principles of Indigenous Data Governance. At each museum, we started our work with a Zoom meeting with the Knowledge Holders to show them the specific collection pieces and to receive their input on what to 3D model. Following consultations, the research team determined which 3D technology was best suited for 3D documentation based on the characteristics of the heritage piece. We used photogrammetry to model pieces that were made of soft material such as fur, leather, and gut. In comparison, we used structured light scanning to model pieces that had complex geometry, and simple surface features, such as pieces made of wood and ivory. For 50 pieces, we employed a combination of structured light scanning and photogrammetry. This yields a comprehensive documentation that preserves a piece's geometric structure and surface.

Each collection presented its own set of challenges. One unexpected challenge was the difference between the pieces within the two collections. For example, as an art museum, many of the pieces at the Hood were made with exceptional craftsmanship and decorated with intricate details. These highly detailed pieces required more time per piece to 2D photograph and 3D document compared to the collection at MPM. The Arctic collection at MPM had nearly three times as many pieces as the Hood, which resulted in a fast-paced environment for 2D and 3D documentation. The team had to adapt and lower the usual number of photos taken for photogrammetry, while still ensuring high-quality 3D documentation. The museum staff generously altered their working hours, so the team could document all Kawerak heritage pieces at both museums.

Fieldwork provided the opportunity for student researchers to apply their skills in a real-world setting, adapting to unfamiliar environments and unexpected challenges. Minor inconveniences in the lab, such as dead camera batteries or misplaced equipment, became major obstacles in the field that could significantly delay our progress. Packing was another challenge, as airline restrictions on luggage weight required us to carefully consider what to bring and what to leave behind.

During the fieldwork experience, Knowledge Holders communicated the personal and community significance of the collection pieces. Their knowledge clarified the importance of knowledge and physical repatriation by emphasizing the concept of heritage pieces as living ancestors. As Lisa explained, breathing the same air and being physically present in the same space as the heritage pieces was a profound experience of reconnection. Collaborating with Tribal Knowledge Holders and handling heritage pieces that have been removed from their origin communities was a clear reminder of the value of ethical, collaborative research and its potential for positive societal impact. Engaging with museum collections can enrich student, museum, and community knowledge about heritage pieces, as object-centered learning of ancestral heritage encourages collaboration with community and local Knowledge Holders (Margaris 2020). The Knowledge Holders guided our research by sharing their stories and knowledge with us. In turn, they brought information about the pieces they viewed back to their communities. For example, at the Hood, a cutting board was inscribed with initials linked to the relative of a Knowledge Holder, and, via Zoom, we were able to virtually reunite her with her family's heritage. This exchange of knowledge includes the museums as well and aids their stewardship of Indigenous collections.



Figure 2. (From left to right) Lisa Ellanna, Julie Raymond-Yakoubian, Ashley Offill, and Medeia Csoba DeHass examine a gut parka at the Hood Museum, 2024. Photo by Abigail Bailey.

Post-Fieldwork Reflections

Collaboration between student researchers and mentors was vital to the success of the research process. Brennan worked closely with Travis Doering and Jorge Gonzales, previously from the University of South Florida, to model pieces with structured light scanning. While working together, Travis and Jorge shared their knowledge and techniques for scanning challenging pieces. At the MPM, Jorge showed Brennan how to position hollow pieces in a way that made it possible to fully scan the interior. At the Hood, Brennan encountered this same issue and was able to utilize the same technique. Addison worked closely with Alexandra Taitt, in 2D documenting Kawerak region collection pieces. Together, they were able to develop an effective workflow that made the task of culturally responsive photographing hundreds of pieces in a short time span less daunting. This was possible because of the collaboration and guidance of an experienced researcher sharing her knowledge with an undergraduate RA (figures 3 and 4).

Sustained and respectful engagement with Knowledge Holders and Kawerak, Inc. was an essential part of our workflow. Travel and our shared focus on project success built a research community. There were instances where these close working relationships were evident due to an exchange of humor. For example, during video conferencing from collections, Knowledge Holders teased Lily for speaking too quietly into the microphone, which caused laughter among all participants.

We also collaborated student-to-student as we discussed the day's work, what was difficult, what was enjoyable, and planned what needed to be done the next day. Through these discussions, we helped each other navigate the challenges of fieldwork. For example, if an RA was having an issue getting the camera to focus, they could turn to the person working alongside them to help troubleshoot. This peer-to-peer collaboration was routine and asking for guidance was encouraged.

While the fieldwork was successful in completing our research goals, there is always room for improvement. We would have benefited from developing a better organization system for our equipment prior to leaving our home institution. During the documentation process, our system of prioritizing heritage pieces for documentation worked well. For instance, Abigail consistently used a macro camera lens, and



Figure 3. Jorge Gonzalez and Brennan Meyerhoff document heritage pieces with structured light scanners at the Hood Museum, 2024. Photo by Medeia Csoba DeHass.



Figure 4. At the Hood Museum, Alexandra Taitt and Addison Vallier photograph a snuff box, while Peyton Smith models a mask with Julie Raymond-Yakoubian looking on. Lily McEwen and Abigail Bailey take photos for 3D modeling, 2024. Photo by Medeia Csoba DeHass.

she almost exclusively modeled small heritage pieces to match the strengths of that lens. We were able to adapt to fieldwork realities through a streamlined workflow process as we prioritized smaller pieces for Abigail, while Peyton and Lily had camera setups better suited for larger pieces.

When faculty mentors include their RAs as equals in research, it benefits both sides of the relationship. By encouraging independent work, the mentors build more self-motivated RAs, which contributes to productivity, while the RAs feel that their voices and opinions are respected and valued (King and Imai 2023). For example, Peyton felt confident in working independently and approaching peers for advice to inform better problem-solving strategies. As for Brennan, through the guidance of research collaborators, he developed a specialized skillset in structured light scanning and became a structured light scanning expert in the lab. Our voices and opinions were valued, contributing to an inclusive learning community. Through long-distance travel and working toward a shared goal, camaraderie developed between us and our collaborators. We created a positive research environment by encouraging open communication and constructive feedback. This allowed for greater cooperation and a well-managed approach to problem solving.

Through this fieldwork process, we established relationships with museum professionals and felt comfortable asking questions about navigating future career opportunities in the heritage sector. We gained transferable and direct skills, such as technology proficiencies, flexibility, and time management. We were able to participate in the real-world applications of responsible and ethical research practices. As a result, we refined our professional goals for the future. Finally, we experienced the benefit of working as a collaborative team engaged in, and contributing to, co-produced research in a positive learning environment.

Conclusion

In the summer of 2024, our collaborative research team came together to 3D and 2D document Kawerak region collection pieces at the Milwaukee Public Museum and Dartmouth College's Hood Museum of Art. Through this fieldwork process, the collaborators intentionally co-developed a learning community. This fieldwork contributed to the larger aim of the research project of reconnecting Kawerak region community members with their cultural heritage through 3D and 2D documentation. This research project was designed and conducted following the ethical research principles and frameworks of co-production of knowledge (Ellam Yua et al. 2022) and Indigenous Data Governance (Carroll, Garba et al. 2020). Without both museums' full support of Indigenous Data Governance, this work would not have been possible.

In the months following the summer fieldwork, the research project has been advancing rapidly. Six months after the fieldwork, in November 2024, five Knowledge Holders traveled to Columbia, Missouri, to engage with the Arctic collection at the University of Missouri Museum of Anthropology. This was the first time the researchers and community members could interact in person, which further strengthened the camaraderie of the research and learning community.

This fieldwork experience showed the application and strength of co-creating a learning community for all members of the research team. Our fieldwork experience also strengthened the relationships between researchers and Tribal collaborators. Fieldwork highlights the importance of learning communities' convergent science approach by co-producing knowledge in spaces outside traditional learning environments. Through applying the co-production of knowledge framework to fieldwork, we created a research environment where all members of the research team, regardless of their role, were valuable contributors.

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