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Creating and sustaining public engagement in spatial humanities and deep mapping projects

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ABSTRACT

There has been a plethora of work produced in the fields of public participatory GIS (PPGIS), spatial humanities, and historical GIS (HGIS) that illustrate the benefits of engaging public stakeholders in digital and deep mapping projects. Scholars have promoted many different public outreach activities and programs that attempt to engage the public; however, little work has been done to evaluate the impact these activities and programs have had in creating and sustaining public engagement. Using the Keweenaw Time Traveler (KeTT) project as a case study, this paper analyses six community outreach activities and programs used to engage the public in the exploration of the KeTT deep map over a one-year period. This analysis uncovers the depth and breadth of engagement users have with the deep mapping environment and provides a set of best practices other projects can use to create and sustain public engagement.

KEYWORDS

Deep mapping; historical GIS; public outreach; public participatory GIS; public engagement; spatial humanities

Introduction

“If you build it, they will come” may be decent advice for building a ballfield in an Iowa cornfield, but it does not necessarily apply to Public Participatory GIS (PPGIS) or similar public facing spatial humanities or deep mapping projects. A robust body of scholarship within the spatial humanities and social sciences has demonstrated the value of engaging members of the public in digital mapping projects. These benefits extend to both academics and members of the public alike. Despite these benefits public participatory mapping projects are often met with significant challenges that center around how to both begin and maintain engagement by the public.

Recently, a new model has been developed that works to fill this gap by creating a framework that acts as a guide for research teams in creating and sustaining public engagement in PPGIS, spatial humanities and social science projects. This study is the first to test the nested pyramid model of engagement (NPME) in a practical setting (Juip et al. 2025). Using the Keweenaw Time Traveler as a case study, we utilize NPME in the creation of a public engagement strategy that is implemented over the course of a year. The model is then used to analyze the

effectiveness of the engagement strategy that was developed. The paper concludes with a set of best practices other projects can use to create and sustain public engagement in their own projects.

Modeling public engagement in public facing projects

The benefits of public participatory mapping research are numerous for both researchers and public alike. The goal of many public participatory mapping projects is to incorporate community values and perceptions with quantitative data from “official” sources (Fagerholm et al. 2021; Kahila-Tani et al. 2016; Kahila-Tani, Kyttä, and Geertman 2019). These projects often work to directly engage stakeholders in social processes including mapping, policy decision making, and heritage work (Brown and Kyttä 2014; Lafreniere et al. 2019; Tulloch 2008). The beneficial outcomes of this work include empowering public stakeholders in decision making and planning processes on projects that directly impact them (Brown and Kyttä 2014; Kahila and Kyttä 2006; Kahila-Tani et al. 2016), the ability to use community perceptions to contextualize quantitative data (McCall 2021;

Verplanke et al. 2016), and growing partnerships between community stakeholders and researchers that solve both academic and community problems (Robinson, Block, and Rees 2017; Robinson and Hawthorne 2018; Winkler et al. 2016).

Along with these benefits come significant challenges. Developing, sustaining, and growing community-project relationships take time and resources making it a continual challenge for the field. The novelty of digital mapping does not naturally lead to public participation in the mapping process. Brown and Kyttä's review of five PPGIS projects in 2014 noted low engagement (averaging 13% response rates in the five studies they review), which continues to stay low throughout the project span. In an effort to understand the ability of PPGIS to “produce high quality and versatile knowledge,” Kahila-Tani, Kyttä, and Geertman (2019) reviewed over 200 public planning meetings where PPGIS was used as a tool to engage the public in policy-making decisions. Though they concluded that PPGIS methods did in fact create opportunities for the production of “high quality and versatile knowledge,” knowledge production correlated with the number and diversity of project participants. It is clear that to be effective, public participatory mapping projects must both create and sustain public engagement in their projects.

The nested pyramid model of engagement (NPME) is the first theoretical model created to guide researchers in this process (Juip et al. 2025). This model (see Figure 1), built specifically for deep mapping projects, integrates best practices from the fields of citizen science, public relations and communications, spatial humanities and social sciences, and public history and interpretation. It creates a framework that both works

to incorporate the unique depths at which stakeholders can engage with a project and also illustrates how spatial narratives can be used as tools to facilitate their engagement.

The upper right-hand funnel illustrates the different depths in which the public engages with a project. Starting with entry level engagement at the rim, the funnel visually illustrates the aim of activities at this level—creating project awareness among members of the public who may benefit from the project but are, as yet, unaware of it. The funnel progresses through four successive levels; its structure illustrates decreasing numbers of people engaging at each level with the least number of individuals engaged at the deepest levels. Each level is defined by the specific nature of engagement exhibited by stakeholders and has goals that work to create pathways for progression to deeper levels. Crucially, each level also has suggested metrics that work to quantify the volume of engagement taking place throughout a project.

The lower left-hand pyramid illustrates how spatial narratives connect stakeholders to digital mapping projects by leveraging the connection between spatial narratives and deep maps. First theorized by Ridge, Lafreniere, and Nesbit (2013) and readapted here, the funnel of engagement illustrates how the individual moves down from shallow, narrative driven, connections with the project, to developing their own vigorous understanding and use of the data within the map as well as its connection to the broader world of data outside it. Successful public-focused outreach activities drive this movement. A project then must design public-focused outreach activities that meet stakeholders at their level and create space for them to dive deeper into the world of data.

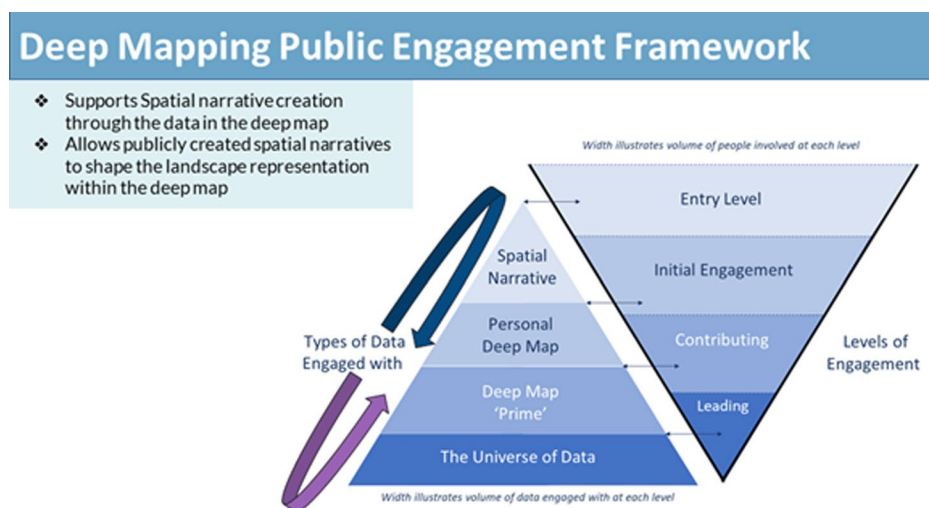


Figure 1. Deep mapping public engagement framework.

The NPME model offers an opportunity to both measure and help design outreach programming that fosters growth in a community-project relationship. However, this theoretical model has yet to be applied. Herein we apply the NPME model to a well-established PPGIS project: the Keweenaw Time Traveler (KeTT) deep mapping project. By applying the model to the KeTT project as a case study we can examine the practical value of this model to spatial humanities and public participatory GIS projects.

The Keweenaw Time Traveler

The Keweenaw Time Traveler (KeTT) is an online historical atlas that encourages and supports public engagement in its robust spatial representation of the first major industrial mining landscapes in United States history (located at www.keweenawhistory.com). The Keweenaw Peninsula, known colloquially as the Copper Country, juts out like a thumb into Lake Superior from its south shore (Figure 2). The impacts of rapid industrialization and deindustrialization, which attributed to the growth and decline of the region's copper mining industry between the mid-nineteenth century and 20th centuries, have had a profound impact on the social, cultural, and environmental fabric of the Copper Country landscape (Lankton 1993, 2010; Scarlett 2023; Stone, Lafreniere, and Hildebrandt 2022). KeTT was built to empower community stakeholders, public officials, and

academic researchers with the ability to gain and share knowledge about how the industrial past of the region impacts the present and to develop discourse about how to leverage this past to create a healthier and more prosperous future (Scarlett et al. 2018).

The Keweenaw Time Traveler is a deep map powered by the Copper Country Historical Spatial Data Infrastructure that has spatio-temporally linked over 630,000 records and nearly 20 million variables from the built environment and populations of the region from the 1870s to present (Trepal, Lafreniere, and Gilliland 2020; Trepal, Lafreniere, Stone 2021). Data is derived from decennial censuses, city directories, school records, and employment rolls. All of the records are spatialized utilizing period specific historical maps with most records geocoded to the exact residential, school, and workplace locations. This deep map affords researchers and the public alike the opportunity to examine geographic and social structures such as families, households, neighborhoods, classmates, coworkers, and more complex systems such as labor patterns, industrial systems, and environmental change (Arnold and Lafreniere 2018; Lafreniere et al. 2021; Scarlett et al. 2024; Stone et al. 2023).

From its beginning in 2015, KeTT has been a collaborative project focused on the co-production of knowledge between researchers and community stakeholders. The mission of the Keweenaw Time Traveler is

...to start conversations about how this region's industrial past continues to affect our lives and identities



Figure 2. Study area: the Keweenaw Peninsula.

today. We work to engage residents, descendent groups, researchers, municipal governments, and visitors in conversation about how to leverage the Keweenaw's past to create a healthier and more prosperous future.

Aligning with this mission, community stakeholders were included in the design process of KeTT's digital interface through many design charrettes. Stakeholders were also able to contribute directly to the initial building of the historical geospatial datasets contained within KeTT through three PPHGIS applications that helped document historic building use, building material, and transcribe unique notations written on digitized historic maps (Lafreniere et al. 2019; Scarlett et al. 2018; Trepal, Scarlett, Lafreniere 2019). Members of the public have been able to continue to add to the data contained within KeTT with Story Points. Using Story Points, individuals can preserve and share their own memories and stories by uploading text, audio, video, images and other multimedia onto the KeTT interface. Their stories are automatically linked to other historical data in the same location creating a much more robust and complex representation of the Copper Country than if only researcher-contributed data were present. Sustained and active in-person programming at local heritage organization sites and festivals, along with blog and social media posts, have kept stakeholders engaged with the project as it has continued to develop over a decade. KeTT's well-established public-project partnership model makes this project an idea candidate to investigate the value of the NPME model as a tool for evaluating and creating outreach programming for public participatory projects (Figure 3).

Public engagement program design

Creating a baseline for engagement

Great outreach programming meets an audience at their current level of engagement and provides opportunities for them to engage more deeply (Beck and Cable 2002; Harrison 2010; Juip et al. 2025). The first step in designing and implementing successful outreach programming must be to identify the current breadth and depth of engagement with the project (Figure 4).

Before designing or implementing new outreach programming for the Keweenaw Time Traveler it was necessary to categorize and quantify the number of individuals engaging with this project. Using the NPME model as a guide, KeTT engagement was categorized into four levels of relative depth as a qualitative assessment of engagement intensity. The NPME model characterizes entry level as the shallowest form of engagement where stakeholders are aware of the project but may not be engaging or contributing to the project directly. Digital engagement methods, such as social media and blog posts, fit well into the entry level as stakeholders may view these posts as they scroll through their social media feeds, but may not be interacting directly with the project.

To quantify the number of stakeholders initially engaging with the Keweenaw Time Traveler's social media we collected three user statistics: post reach, page followers, and post engagement for the full month of July 2022 from Meta Business Suite—the business manager application for the KeTT Facebook page. Post reach is defined by Meta as “the number of people who see any post at least once.” This specific metric was categorized as the shallowest form of

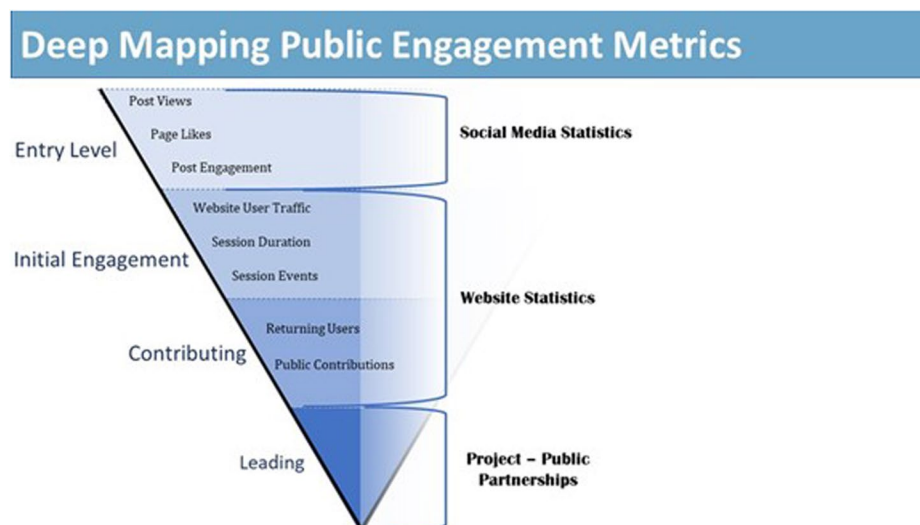


Figure 3. Initial engagement statistics placed within the NPME for analysis and reflection.

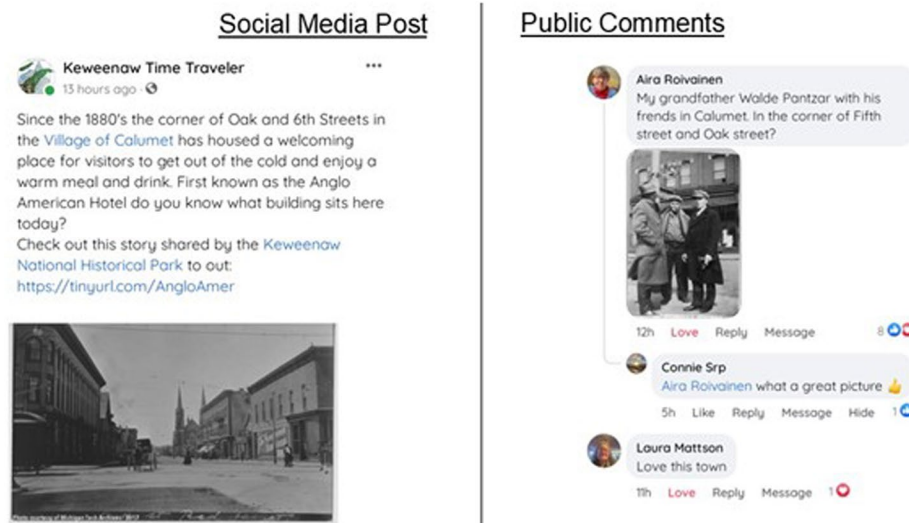


Figure 4. An example of a social media post and the public comments associated with the post.



Figure 5. Family engages with the 'draw my copper country memory' program - encouraging young children to share their place-based memories on KeTT.

engagement, representing simple awareness of the project. Page followers were also included as a layer of "entry level" engagement. Post engagement, defined by Meta as "the number of reactions, comments, and shares that posts receive" was categorized as the last layer of "entry level" engagement, as stakeholders are actively engaging with material posted on social media. Crucially, social media post reach, page followers, and post engagement do not indicate direct engagement with KeTT itself. As a result, these quantifiable measurements fall firmly within the "entry level" stage of the NPME model of engagement (Figure 5).

The "initial engagement" level is the second shallowest form of engagement categorized by the NPME model. Engagement at this level is marked by direct engagement with the project by a stakeholder. At this level, interactions between stakeholders and the digital

project are straightforward, simple, and require very little commitment of time and energy. To measure the volume of stakeholder engagement at this level we used three metrics: website user traffic, session duration, and session events collected from Google Analytics' reports on the Keweenaw Time Traveler website, again for the month of July 2022. To accurately measure stakeholder engagement at this level we must consider how many individuals interact with KeTT, but also how long they stay on the site, and how many things they explore during that time. Website user traffic is defined by the total number of site users during the month and mean session duration captures how long stakeholders engage with KeTT. Finally, the number of session events records how many unique pieces of data individuals are exploring during their sessions. Together, these three metrics work to quantify "initial level" engagement within the NPME model by measuring direct engagement with the KeTT project.

Deeper and more complex engagement is measured in the "contributing" stage. This level is characterized by users increasing their engagement with the project by adding their own data and stories. To quantify "contributing" engagement with KeTT, we collected the number of returning users from Google Analytics as well as the number of user-submitted story points, which we tabulated again throughout the month of July 2022.

"Leading" is the deepest level of engagement defined by the NPME model. This level can be characterized by a flip in the project-stakeholder relationship. Instead of the project team inspiring the stakeholder to engage more deeply with the project, the stakeholder actively engages others with the project. Often,



Figure 6. Quantitative results from the implementation of the public engagement program.

stakeholders at this level have been inspired to actively utilize the project interface or data as tools in their own projects. Quantifying engagement at this level can be difficult. We reflected on our mission, which encourages community engagement in conversations about how the Copper Country's industrial past shapes our lives today and can be leveraged to create a better future for all, and felt the best way to measure growth in the leading engagement level would be to measure the number of community partners who have reached out to the KeTT team to support their own heritage work. The summary of the quantitative results of this baseline study can be seen in Figure 6.

Developing an outreach strategy

Using the baseline study as a starting point, we developed an outreach strategy targeted to create pathways for both deeper engagement and broader awareness of KeTT. Our aim was to measure increases in the quantitative measurements of the four levels of engagement by conducting a year-over-year comparison for the same month of July. To effectively design our strategy, we drew on a mixture of methods from the fields of public participatory GIS, public humanities, interpretation, public relations and communications. Our strategy sought to grow project awareness through social media, static and in-person public programming, and through support of community heritage partner projects.

Project awareness through social media

One of the major foci of our outreach strategy was to raise project awareness among those with an

interest in the history and heritage of Michigan's Copper Country, the moniker for the Keweenaw region. To develop effective outreach programming that increased awareness within this group, we drew largely on the fields of public relations and communications where recent work has occurred on digital outreach and its impact on positive brand awareness and brand-public relationships. Within these fields, social media has been demonstrated to be an effective tool in developing brand-public relationships by growing positive relationship dimension (Thompson et al. 2018). Scholarship has also illustrated that brands that grow a more "human" presence on social media platforms, as contrasted with a more "organizational" presence, have had more success growing brand-public relationships (Park and Lee 2013; Thompson et al. 2018). These platforms also afford the unique opportunity for the public to be active participants in the co-creation of public relation activities, instead of just recipients (Popp et al. 2016).

We leveraged these ideas by developing a robust social media campaign on Meta's Facebook platform that aimed not only to strengthen relationships between the public and the Keweenaw Time Traveler but also to engage the public as active participants in the process. Posts were released the same time of day every Monday, Wednesday, and Friday in an effort to develop trust through stability and continuity. Each of these posts highlighted a story point submission from a member of the public that could be found on the Keweenaw Time Traveler. Each Facebook post credited the individual who developed the story submission, shared photos included in the submission, highlighted the major theme of the story, and, using active language, encouraged viewers to click on a link

to the story on the Keweenaw Time Traveler to learn more. The intentional framework of these posts was intended to illustrate to the public that they are active participants in the co-creation of Copper Country heritage knowledge on the Keweenaw Time Traveler deep map.

Pathways toward deeper engagement through social media

The second focus of our strategy was to develop new pathways and widen others for stakeholders to move toward deeper engagement with the Keweenaw Time Traveler. Our approach involved both impersonal and in-person programming techniques inspired by key theoretical principles drawn from the field of interpretation. Impersonal programming is defined as a program that does not involve the interpreter and the audience meeting in person (Beck and Cable 2002; Tilden 1977; Westrup 2002). Common examples include, but are not limited to digital interpretation, interpretive movies, trail signs, and exhibits. Personal interpretive methods require direct face-to-face engagement between an interpreter and an audience (Beck and Cable 2002; Howard 2003; Tilden 1977). Both have been seen as widely effective methods for interpretation.

Framed around the 15 principles of interpretation laid down by Beck and Cable (2002), we developed systematic self-directed programming that worked to spark an interest in the history of the Copper Country landscape (Beck and Cable's first principle of interpretation), bring the past to life (Beck and Cable's seventh principle), through programming that aimed to provoke an interest in the area's past and also how the Keweenaw Time Traveler can be used as a tool to both represent this landscape and investigate it.

One of the impersonal programs we developed was entitled "Find me Friday." Using the Keweenaw Time Traveler deep map on a mobile phone (which has a different interface from a desktop), a KeTT team member would travel to a place of historic significance within the Keweenaw Peninsula. They would pull up a historic map that represented the past landscape of that area and take a screen shot. Then they would use their mobile device to take a picture of the landscape today. Each Friday, the team would post the screenshot of the historic map along with archival photos of the area and a short history of the landscape. The post would end with a call to action, asking Facebook users to use the Time Traveler to figure out what is present in the landscape today and post their answers and pictures of the place in the

comments below. The following Monday, the KeTT team would post their photo of the landscape and a short description of what was present today. These posts drove people to engage with the deindustrialized Copper Country landscape and touched on themes of adaptive reuse, industrial ruins, and community memory. Through these steps, the program was not only intended to inspire interest in KeTT but also in the way KeTT can be used to visualize how the landscape has changed over time and the forces that have driven that change.

Pathways toward deeper engagement beyond social media

Another self-directed program implemented by the Time Traveler team was entitled Postcards from the Past. To implement this program, the KeTT team leveraged the massive number of individuals whose historical records have been record-linked and mapped to their residential locations. Using the power of the deep map, team members found houses that still exist in the landscape today and mailed a physical postcard to the current residents of the house introducing them to the historic residents of their home. For example, a postcard might say,

Did you know that in 1910 your house was home to William Jeffrey, a copper mine laborer from Chacewater England, his wife Kate and their three children? Explore the historic atlas at keweenawhistory.com to learn more!

Over 250 postcards were sent out to Keweenaw residents with 160 sent in December of 2022 and the remaining 90 sent in the beginning of February 2023.

In-person programming was an equally important part of our engagement strategy. The KeTT team designed six in-person activities that could be implemented by a small number of staff, primarily students, intended to reach a broad and age-diverse swath of the community. In-person programming was developed for a number of regional festivals including Pasty-fest in Calumet, Bridgifest in Houghton, Lake Superior days in Copper Harbor, and Strawberry Fest in Chassell. The events were chosen based on their timing throughout the summer as well as their geographic spread throughout the Keweenaw. It has always been a central tenant of the field of interpretation that interpretive programs for children and young adults should be built differently than those for adults and should address their specific needs (Beck and Cable 2002; Tilden 1977; Uzzell 1998). We also recognized children's memories and reflections are important in the understanding of a landscape

and have been studied extensively by geographers. Giving children a voice in the representation of their geography has been seen as a powerful pedagogical tool (Catling 2014) as well as a tool for developing civic engagement and spatial learning skills (Gordon, Elwood, and Mitchell 2016; Loebach and Gilliland 2010). Therefore, we designed distinctive programs aimed to engage these two groups and their families.

An example of one of these programs is entitled, “Draw your favorite Copper Country Memory.” It was designed to engage young children and their families in the use of KeTT. Children are given a large sheet of paper and coloring utensils and asked to draw their favorite memory from the area. As they draw, the interpreter asks them questions about their drawing working first to understand the significant people, buildings, and environmental features in the drawing. Most importantly, the interpreter works to get the young child to explain why they chose what they are drawing and why it matters to them. When the drawing is complete the interpreter works with both the child and guardian to upload the drawing as a story point feature on the KeTT deep map. KeTT staff not only introduce the child and guardian to the process but explain the importance of story points; those story points offer people an opportunity to share the memories and stories that they feel are important to Copper Country history allowing people to tell stories that matter to them. In short, they make the story point feature seem both meaningful and accessible. This project creates a deeper engagement with KeTT while also creating a new method for representing the voice of children in the heritage discourse of the Copper Country.

During the fall and winter, KeTT team members attended and implemented in-person programming at events that worked to engage local middle and high school students. Overall, the KeTT team implemented these programs at nine community events throughout the Copper Country over the course of the study.

Supporting community partners

The programming developed and implemented as described above worked not only to create awareness of the KeTT project but also to open avenues to deep levels of engagement as described in the NPME model. To move project participants to the “leading” level of engagement, we devoted KeTT resources specifically to support community-driven projects. As described above, “leading” project participants are already deeply engaged with the project and are actively working to engage others. As community

heritage organizations and school groups approached us with project ideas that included the use of KeTT, we worked to provide the resources they needed to support their projects and to achieve a positive outcome. These included local heritage organizations, high school classes, and local businesses. Over the course of this study, we supported six community-led projects.

In its totality, this outreach strategy was designed to both increase project awareness and create pathways for deeper stakeholder engagement with KeTT. We based our engagement strategy on our baseline study framed by the NPME. The outcomes from the implementation of this engagement strategy not only reflect the effectiveness of our strategy but also shed light on how valuable the nested pyramid model of engagement is as a tool to both measure and help design outreach programming for public-facing projects.

Results

Quantitative results

The aforementioned public programming strategies were implemented over a one-year period between July 2022 to July 2023. To evaluate the impacts of our new public programming activities, we compared indicators from before the study period (July 2022) with indicators after the study period (July 2023). [Figure 6](#) presents the quantitative results of our engagement activities.

All indicators for engagement with KeTT at all levels showed substantial positive change between July 2023 and July 2022. In the year before the study period, sixty-four Facebook posts were released sporadically throughout the year when the KeTT team wished to share news and updates with project followers. In contrast, during the study period, 152 posts were released on a systematic schedule targeting the times at which most Facebook users are most active throughout the week. These posts followed positive brand awareness and brand-public relationship growth models discussed above by leveraging the stories already shared by members of the public on the Keweenaw Time Traveler. Each post celebrated the work done by a member of the public by linking directly to their story point in KeTT, and by highlighting its importance to Copper Country history. Through this process, we humanized our social media presence and illustrated our commitment to public participation. On a deeper level these posts encouraged engagement through social media comments

while also inspiring others to share story points on KeTT.

During the implementation of this strategy, data show a marked improvement in engagement. Data from Meta illustrated that 37,670 more individuals viewed KeTT posts in July of 2023 as compared to July 2022. This indicates that during the study period KeTT developed substantial positive brand awareness. Meta metrics also show that the number of new followers of the KeTT Facebook page more than doubled one year later for the same time period. Engagement in our Facebook posts saw a 500% increase year over year with qualitatively more engaged conversations taking place as well. These two metrics indicate that positive growth was also occurring in our “project-public” relationship. Our vision of a co-created public-facing deep map that celebrates public heritage work through spatial storytelling really resonated with members of the public as illustrated in the marked increase in post engagement and growth in KeTT Facebook followers. These quantitative results clearly indicate that this targeted, sustained, and celebratory social media campaign successfully met its aims in increasing project awareness and developing positive “project-public” relationships. This social media campaign was also integral to driving deeper engagement with KeTT.

The social media campaign discussed above drove significant increases in the “contributing” level of engagement. Notably, July 2023 saw double the user traffic and events per session on the Keweenaw Time Traveler deep map online as compared with July 2022 according to Google Analytics. User traffic refers to the movement of visitors from different web sources to a website, and this metric includes both new and returning visitors. Out of the 745 total visitors to the site 231 or 31% of site visitors arrived at the site *via* a social media site during that time period, an increase from only 9% of total visitors in July of 2022. This illustrates how effective the social media campaign was in engaging potential project stakeholders with KeTT directly indicating its value in creating “contributing” level engagement. During July of 2023, KeTT also had 200 returning users as opposed to 88 in July of the previous year. Google Analytics defines “returning users” as individuals who have visited a website and returned for another session during the reporting period. This indicates growth in the number of individuals continually interacting with KeTT, which supports growth in the contributing level. Importantly, 24 new story points were added during July of 2023, a marked rise from the 2 stories shared in July of 2022. Stories allow anyone with

historical-spatial knowledge about the Copper Country to share it through a variety of media within the deep map. In short, they allow people to share their stories and historical knowledge their way. The increase in story sharing on KeTT illustrates a direct increase in engagement at a contributing level.

The contributing level of engagement was not just influenced by social media and virtual programming. In-person programming at both summer festivals and fall school events throughout the study period also influenced engagement at this level. During this time, KeTT had made meaningful in-person connections with over 760 individuals over the course of the summer, and another 117 K-12 students in the fall and winter. The “Draw your Favorite Copper Country Memory” program added 29 story points to the Keweenaw Time Traveler over the course of the year and accounted for 8 of the 24 new story points in July of 2023. The Postcards from the Past program delivered 250 postcards to homes throughout the Copper Country over the course of two separate weeks. The week following each postcard release showed a not unsubstantial increase in user traffic, 20.6% and 33.1% over the average traffic of the preceding three weeks respectively.

Though it is difficult to measure growth in the “leading” level of engagement in a quantitative manner, we note that six new community partnerships were formed over the course of the study. All of these new partnerships started as a result of community partners reaching out to the Keweenaw Time Traveler team seeking support for their own heritage project ideas.

These projects included a collaboration between KeTT, the Painesdale Mine and Shaft (a Keweenaw National Historical Park Heritage Site), and a local high school history class from Jeffers High School in Painesdale, Michigan. Their history teacher reached out after visiting the Keweenaw Time Traveler booth and at a fall program for 8th grade STEM students at Michigan Technological University. During their class on local history, students noted that their community’s role in the larger history of the Copper Country was, from their perspective, often overlooked and underappreciated. Similarly, they noted that tourists exploring and investigating the regional mining history often drove through their community to visit regional heritage sites elsewhere. To rectify this oversight, students planned on developing signs around town and on the former rail line now utilized as an ORV and snowmobile trail that would not only share community heritage but also draw visitors off the roads and trails to explore and spend time in Painesdale

itself. Recognizing KeTT's role in sharing community-driven heritage narratives, the class reached out for support in developing and implementing their signage project. The KeTT team supported various student activities including field work (locating appropriate placement for interpretive signs, investigating industrial remains, and site walk-throughs), archival investigation, and student education on interpretive practice. Collaboration on this project is still ongoing.

KeTT was also a key partner in the Chassell (Michigan) Heritage Trail project which was led by the Chassell Heritage Organization (CHO), a small volunteer-only community heritage organization. CHO reached out to KeTT after the team ran public programming at the Chassell Strawberry festival. Members of the CHO board stopped by the KeTT booth, participated in programming, and started initial conversations about the trail project.

The initial aim of the CHO trail project was to provide public access to the reclaimed shore of Pike Bay. This trail created a unique opportunity to share the often-overlooked history of logging and lumber milling in Chassell through interpretive signs. However, two challenges were identified that signage alone did not meet. First, the interpretive signs provided a poor spatial and temporal context to the story of the mill and its operations especially since few remnants of these structures remain on the site. Second, the narratives developed for the interpretive signs were designed to reach an adult audience. Interpretation on the site was missing the opportunity to engage young children in the history of landscape and why it mattered. To meet these challenges, KeTT developed a digital story book and integrated it into the deep map of KeTT (Juip et al. 2025). Each page of the story could be read by scanning a QR code on each interpretive sign. The advantage of integrating this story book into KeTT is that this approach allows trail visitors to close a story page and seamlessly use KeTT as a deep map *in situ* to explore the former mill sites using historic maps that cover a temporal period from 1865 to the present day.

Through the partnership created with CHO, KeTT team members have been asked to speak about the value of KeTT and its role in local heritage at five community heritage events supported by CHO. KeTT's role in this project has also been shared on local news sources including six newspaper articles, a spot on the local nightly news, and a 20-minute special on *Discovering U.P.*, a weekly T.V. program developed by a local NBC affiliate. This partnership continues to grow as CHO plans to develop a historic homes tour that will be supported through the KeTT deep map.

These two projects with Painesdale students and the CHO are excellent examples of the connections and growth in public outreach that have been created by these "leading" level projects. They also illustrate that "leading" level relationships can grow from public programming done at community events. Of the six community partners discussed here, four said that they became aware of KeTT through social media, but all six decided to contact us to seek support for their projects after experiencing our in-person programming at a community event.

Qualitative assessment of impacts

Numerical data is only one way of reflecting the impact that the implementation of new engagement programming has had on public engagement with the KeTT project. Beck and Cable (2002) and Davey and Benjaminsen (2021) note that holistic qualitative reflection has been seen as an effective tool for investigating the success of engagement programming in meeting interpretive goals. Therefore, we utilize qualitative reflection on each part of our outreach programming plan to help determine how well its implementation has met our project mission to create conversations around the industrial past of the Copper Country and how it impacts the lives of people today.

Not only did our social media outreach create substantial increases in post views, page followers, and engagement with our posts, it also created a unique platform in which discourse about Copper Country heritage could occur. Many posts like the one in Figure 7 inspired a wide variety of comments that illustrated how these posts provoke engagement and connect individuals not just to the KeTT stories but to the Copper Country landscape and its history.



Figure 7. Example of how the Keweenaw Time Traveler deep map can support community-driven heritage projects.

Often comments illustrated the pride that individuals have in their connection to a place such as “[w]e are strong Copper Country people.” People are often inspired to share their connection to a place and sometimes include personal photos from their own collections. These posts also inspire people to ask questions about the landscape, sometimes questioning where, when, or why an event took place and opening more conversation.

Sometimes posts inspired individuals to reach out to KeTT through email or private messages. These messages sometimes included questions about how to use the application, but sometimes individuals, school groups, or community heritage organizations would reach out and ask how the Keweenaw Time Traveler could support their work. These emails and private social media messages indicate that this type of outreach is inspiring individuals to engage with the project at deeper levels (Figure 8).

Our programming efforts also facilitated use of KeTT as a deep map. Our activity, “Postcards from the Past” inspired one of these interactions. After receiving a postcard in the mail, a Keweenaw resident reached out to the KeTT team with a social media message thanking us for the postcard as well as to share the exciting information they had already collected about their home and the people who had lived there in the past. The residents reached out to highlight that they had created a “story point” about the information they had gathered over the years about their home and prior residents. Post cards from the Past did more than just increase usage of KeTT as a deep map. It connected people who received these cards to the history and life of their homes. It allowed them to use KeTT as a space for heritage making, drawing personal connections to the larger bodies of data embedded in KeTT as a deep map.

The implementation of this public programming plan has created pathways for engagement with the project at its deepest level. A prime example of these project-community partnerships is the preservation and dissemination of the oral histories of Armand Pellerin. Shortly after the implementation of our outreach programming the KeTT team received an email from Dennis Pellerin, the son of the late Armand. Dennis had heard about KeTT through social media. He explained that his father had left him an envelope to open when he had passed away that contained a cassette tape recording his memories about growing up in the nearby village of Lake Linden in the 1930s. Dennis wanted to upload these memories to KeTT as stories to memorialize his father but needed technical support. The KeTT team created digital files of Armand’s stories and added a story point on KeTT which was directly linked to Armand Pellerin’s census records as well as the various locations mentioned in the records. Using KeTT, anyone can search Armand Pellerin’s name and find not only his historical records, but also locate the various places he mentioned and listen to all 16 of his oral histories. Some months later, the KeTT team was providing programming at an event for area middle and high school students. A young person from Lake Linden middle school sat down at the KeTT table and began to search for her home on the digital atlas. After a half-hour, team members noticed that she was still sitting in the booth, only now she had headphones connected to her tablet. When asked if everything was okay and if she had found her house she replied, “I did! There is this guy named Armand who lived there! He had a puppy like me, he picked blueberries like me, and he even sledded down the same hill!” This interaction indicates that the collaboration between Dennis Pellerin and the Time Traveler has met the aims of

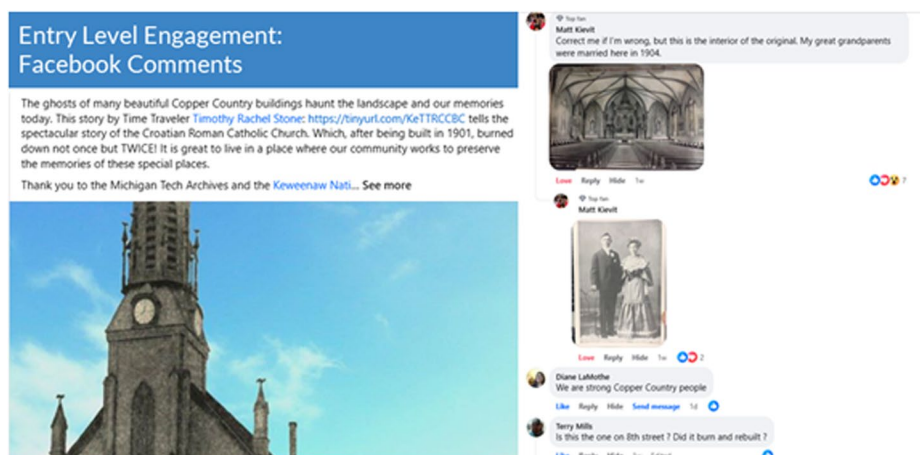


Figure 8. Clips from a Keweenaw Time Traveler Facebook post illustrating the discourse taking place on the page.

Table 1. Breakdown of public programming development and implementation for the Keweenaw Time Traveler during the study period.

Program type	Total design and development hours	Total implementation hours	Average weekly implementation hours
Social media	182	156	6.5
Self-directed	298	251	10.5
In-person	320	297	11.8
Support of leading level projects	257	235	9.5
Totals	1057 (~20.3 hrs/week)	939 (~18 hrs/week)	38.3 hrs/week

“leading” level engagement because it inspired a deeper relationship between a young person and her home and her community. This spatial relationship connecting past and present has linked together these two individuals who grew up in the same house 100 years apart (Table 1).

Through the use of qualitative reflection, it is clear that each engagement method used in this study has had benefits twofold. First, each method has engaged targeted audiences in the active use of the Keweenaw Time Traveler. More importantly, each engagement method implemented during the study has also driven participation directed toward the main goal of the project—creating opportunities to recognize how the Copper Country’s past impacts the lives of people and landscape of the Copper Country today.

The cost of public participatory spatial humanities

The benefits gained through using the NMPE to develop and implement a targeted engagement plan did not come without risk or cost. Developing community-project partnerships does come with some risks. When deep mapping projects support the work of community partners, the quality and content of work produced by those partners reflect on the deep mapping project as a whole. A partner’s work can impact the “project identity” that a team has worked hard to build as part of their entry level engagement strategy. Similarly, opening a project to the public, creating space for public contributions to the data, and allowing members of the public to use the deep map for their own purposes also creates risk for the project. As community members have agency, they may operationalize the project for their own needs in a manner that does not necessarily reflect well on the project or work toward the goals and mission of the project team. To help better understand and mitigate these potential risks, project teams could consider implementing relational risk management systems that

recently have been employed in the fields of marketing and business management (Sarasvuo, Rindell, and Kovalchuk 2022; Scandeliuss and Cohen 2016; Szczepański and Światowiec-Szczepańska 2012).

Along with these risks come costs. During the course of this study, over 1,996 person hours were invested in the design, development, and implementation of this program, the equivalent of approximately a full-time equivalent staff position. The chart below illustrates how these hours were distributed between the four types of programming implemented and how much time was devoted to design and development as compared with implementation. Designing and implementing this robust engagement plan for the Keweenaw Time Traveler took significant effort and resources. The costs associated with each aspect of an engagement program are important to consider when reflecting on the overall value of a public participatory HGIS project.

The design and development of a systematic social media campaign took 182 h over the project period. The bulk of this effort included creating a framework for posts that celebrated the public heritage work of community members in sharing their stories, connected people to the deep map, and used humanizing and engaging language. This work was informed by analyzing 23 social media campaigns developed by other Copper Country heritage organizations and also by investigating the peak usage times for our social media audience to optimize the timing and spacing of Facebook posts throughout the week while also optimizing viewership and retention rates. After the initial lift of 182 person hours to develop the campaign, the implementation took about three hours per week on average. This time was devoted to researching engaging stories on KeTT to share, adding photos and supporting information through archival research, and the act of writing and organizing post releases. It is worth noting the social media campaign drove the greatest amount of project awareness for the average weekly hours of implementation. However, while the social media campaign did support community members engaging with the deep map directly, it did not make as much of an impact as self-directed and in-person programming at driving “contributing” engagement.

Both self-directed and in-person programming efforts took substantially more design, development, and implementation hours than the social media campaign, totaling over 600 h. Many programs that targeted specific age groups and Copper Country communities had to be developed to effectively reach a broader and diverse community audience. Many

programs were developed to be used in elementary, middle school, and high school classrooms, which meant researching and meeting Michigan curriculum standards for each respective age group. Coordination with community event organizers also took a substantial amount of time. To successfully implement these programs at community events two to five individuals were required, which increased the total implementation hours for these programs. Though the time cost was much greater and the over-all increase in project awareness was far less than through the social media campaign, it is imperative to note that all the six community-project partnerships developed in this study were driven by these in-person programs. To these project partners it was our programming taking place at community events that inspired them to reach out and ask us to partner in supporting their projects.

The KeTT team invested a substantial amount of time resources in these six partnerships themselves, nearly 600 h. Project design and development took less time than programming efforts. Still, traveling across the Keweenaw to attend project scoping meetings with different project teams added up quickly. The implementation of these projects also took a substantial amount of time. Each project had its own unique aims and unique methods for meeting these aims. There is no template that could be created for one project and applied to meet the needs of others. The singular nature of each project required the co-creation of unique digital and physical tools. Investing time into each project was also an important investment of time into each relationship. All of these relationships are ongoing and have spawned new ideas for future partnerships while also opening avenues and opportunities to share KeTT with new audiences. The value of investing project time in these relationships cannot be overstated.

In summary, the benefits of implementing this type of robust engagement strategy come at the cost of a project team member's time that could be utilized on other aspects of the deep mapping project. However, if we, as deep mapping scholars and practitioners, are serious in our assertions about the value of engaging the public in our projects, we must be prepared to invest this time. Investing the equivalent of a full-time staff person's time into public outreach has created massive increases in public awareness, project use, public contributions and a host of community project partnerships that the Keweenaw Time Traveler will benefit from for years into the future.

Collaboration between spatial humanities projects may help solve some of these problems. By collaborating with other public facing heritage projects, teams

could share successful outreach programs and reduce time spent on development and design. This reduction in time costs could allow more time to be diverted toward implementation public programs, this increasing engagement for all collaborating projects. Collaborators could also develop shared risk management plans to balance the risk of public engagement with its substantial benefits.

Conclusions

While spatial humanities scholars have espoused many interdisciplinary public participatory methods and used many technologies, they have not created a model that both identifies methods of public participation and also allows for sustained project evaluation. Until this study, such a model has remained in the realm of theory. The nested pyramid model of engagement (NMPE) introduced in this article integrates best practices from the fields of citizen science, public relations and communications, spatial humanities and social sciences, and public history and interpretation to fill this gap. In this study we practically applied this model to an existing public facing deep mapping project (the Keweenaw Time Traveler). The NMPE was used to measure breadth and depth of past public participation with the project, design a new targeted public engagement plan, and measure the impact of the implementation of this plan.

Our results illustrate the immense value that the practical use of this model had for public engagement with the Keweenaw Time Traveler project. Quantitative analysis integrated with qualitative reflection developed within a NPME framework illustrates many positives in project participation throughout the program's implementation from July 2022 through July 2023. Quantitative analysis illustrated growth in all model levels over the course of the study. This growth was driven by the implementation of a yearlong public engagement program driven by the interdisciplinary and mixed modal methods framed by the NMPE. Social media outreach developed through positive brand awareness and brand-public relationship frameworks developed by the fields of public relations and communications created massive increases in entry level engagement with KeTT. Initial and contributing levels of engagement increases were supported by targeted self-directed and in person programming aimed to inspire direct engagement with the Keweenaw Time Traveler while also reaching a broad audience. Finally, these quantitative results illustrate how successful programming in the entry, initial, and contributing levels of engagement inspired community heritage partners

to reach out to the KeTT team and include the team as partners in the design and implementation of their own projects that incorporate the KeTT deep mapping platform as a central element.

Linking these numbers with the social media outreach, self-directed, personal programming, and support for “leading” level community driven projects through qualitative reflection illustrated that the engagement program was also successful at creating pathways for the public to engage with the Keweenaw Time Traveler at deeper levels. Reflecting on project-public partnerships formed and supported in the leading level of engagement revealed how these pathways often operated. During initial conversations with the six new community partners gained during the study period, all six stated that they found our project through social media, and four of the six reached out to us after experiencing our programming at a community event. These conversations illustrate the effectiveness of each level of programming in creating avenues for members of the public to engage more deeply with the Keweenaw Time Traveler project. For those engaging with the project on its deepest level, awareness was developed at the entry level through the social media campaign, inspiring them to attend one of the public programming events. This programming further inspired these community partners to envision how they could use the Keweenaw Time Traveler to support their own heritage projects effectively moving them through the initial engagement and contributing phases into the leading level. This qualitative reflection shows the importance of implementing this program as a whole and how piecemeal implementation would disrupt these pathways.

Together the quantitative and qualitative analysis of the data illustrates that the use of the NPME model in the creation and implementation of a systematic engagement plan had a direct and positive impact on engagement with the Keweenaw Time Traveler deep mapping project. The NPME provided us tools to reflect on both the volume and depth of engagement occurring with KeTT at the beginning of the study. This early analysis allowed for the creation of targeted activities to improve engagement. The quantitative and qualitative analysis performed at the end of the study period indicated that the engagement program was highly successful, increasing both the breadth and depth of engagement when compared with engagement methods performed before the study period.

This study addresses the gap between theory and practice by validating the Nested Pyramid Model of Engagement as an effective framework for both growing and sustaining public engagement in deep

mapping projects. The Keweenaw Time Traveler case study, discussed in this work, demonstrates how an interdisciplinary approach, structured within the NPME, can successfully cultivate public participation, moving beyond a passive “if you build it, they will come” mentality. This study’s integrated quantitative and qualitative analysis illustrates that the NPME not only increased the volume of engagement with the KeTT but also created clear pathways for deeper involvement. In doing so, this study provides a proven blueprint for PPGIS and spatial humanities scholars to design, implement, and measure outreach strategies that both grow and sustain project awareness while also transforming casual project users into dedicated collaborators.

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