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‘Iwikuamo‘o: The Backbone of Native Hawaiian STEM Education

(a) Need for project

Magnitude of the need for the services

Science is a systematic approach to understanding the natural world through observation and experimentⁱ. This approach has enabled the Great Pacific Migration from South Asia throughout the Pacific to the West Coasts of the Americasⁱⁱ. Native Hawaiians have possessed a body of scientific knowledge (astronomy, meteorology, oceanography, engineering, agriculture, and aquaculture) to travel across the Pacific for centuries

The history of Native Hawaiian education and exploration comes as a stark contrast of the current status of educational attainment among Native Hawaiians.

Currently, the demand for science, technology, engineering, and mathematics (STEM) workforce is fast-growing.^v However, Native Hawaiians have been underrepresented in STEM careers due to lower educational attainment^{vi}. Native Hawaiian students are more likely to attend schools with teachers, not adequately trained or certified to teach math and science, and where math and science performance is below the national average. Compared to other ethnic groups in Hawai‘i, they score lower on math and reading in 4th and 8th grades^{vii}, are less likely to continue their education beyond high school^{viii}, earn less than the state average^{ix}, and are more likely to be unemployed, in poverty, or incarcerated^x. In what becomes a vicious cycle, parental income is a strong predictor of a child’s lifespan, health, and educational achievements^{xi}.

One of the significant issues for Native Hawaiians is their erasure from the whole spectrum of STEM education. Native Hawaiian teachers and administrators are underrepresented and underemployed across Hawai‘i. While the student body is 26% Native Hawaiian, only 10% of

teachers are Native Hawaiian^{xii}. Recently the Hawai‘i State DOE recognized that recruiting and retaining qualified staff with Hawaiian language skills is a crisis and equity issue^{xiii}, which negatively impacts Native Hawaiian students.^{xiv}

Moreover, Hawaii’s students historically study mainstream, textbook-based science, but do not learn about Native Hawaiian science practices – navigation by stars, building canoes and voyaging, Native Hawaiian agricultural and ethno-botanical practices, traditional medicine, solar and lunar calendars, and its relationship to ocean, winds, and stars^{xv}. Disconnects from their own identity and culture serve to perpetuate the under-representation of Native Hawaiian students in the STEM pipeline. Repeated studies have found that these distances can be diminished through science education that is based on Native history, ecology, and culture.^{xvi}

Specific gaps and weaknesses in STEM education in Hawai‘i

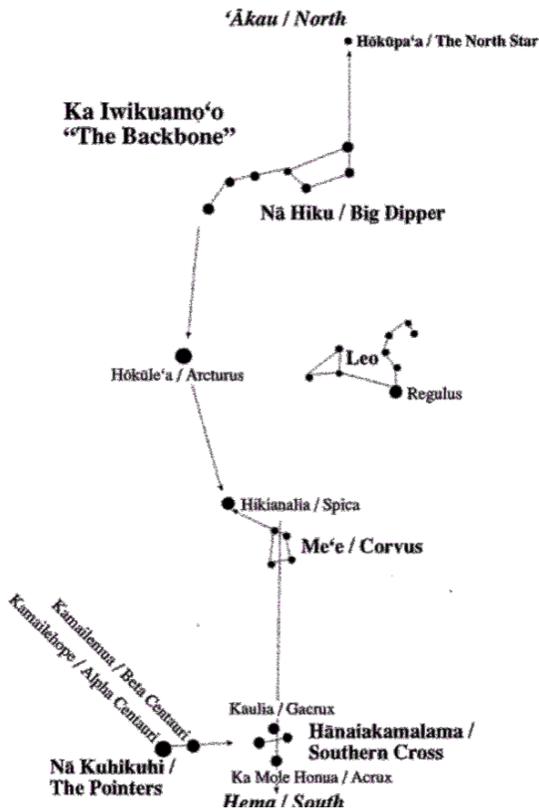
Kūlaniākea is a 501(c)(3) Native Hawaiian-serving nonprofit research, development, and service organization. Our mission is to advance Indigenous education. The vision is to serve Native Hawaiians through multigenerational, educational opportunities. Kūlaniākea operates a lab preschool in Kāne‘ohe, Hawai‘i, which delivers Native Hawaiian culture-based education to both children and adults. The preschool serves 16 children, 88% of them are Native Hawaiian/Pacific Islanders. 80% of our families receive needs-based preschool scholarships and/or subsidies. Our academic program is full-time, 180 school days of 8 hours each.

Since 2018 Kūlaniākea has been working on developing a bilingual academic STEM program for children and a professional development program for Native Hawaiian educators, both of which have been shared and pilot-tested with our educational partners.

Last academic year, our students demonstrated a high degree of social, emotional, linguistic, and academic development. Our pilot showed that the implementation of these elements

is logistically feasible for our organization and can be deployed together. However, the process

As a result of our previous work, Kūlaniākea proposes *‘Iwikuamo‘o* project to design and develop a culturally-, linguistically-, and age-appropriate STEM program for Prek-Grade3, education in voyaging and navigation has been provided only to adults.



‘Iwikuamo‘o (the Backbone) is a traditional star line, that runs from the North Star to the Southern Cross. The celestial line represents a centuries-old navigational map for voyages within the Pacific Ocean and a connection to the Polynesian identity, history, culture, and ancestors of the modern Native Hawaiians. Kūlaniākea uses ‘Iwikuamo‘o as a tool to teach children about individual constellations and scientific thinking. From our pilot we know that children are capable of learning it.

The project will connect the traditional Hawaiian and Western STEM, Hawaiian and English literacy to create a tool for educators and students to navigate the current educational landscape. This program will make this educational available to children.

(b) Quality of the project design

Project Design

Our project aims to address the need for highly-qualified and credentialed Native Hawaiian teachers, the driving factor for students' outcomes. Our design is built on tried-and-true philosophy that educators (both teachers and administrators) are the foundation of quality education^{xvii}. Effective educational programs share specific characteristics: a rigorous curriculum, professional capacity among staff, and a student-centered learning climate.^{xviii} Educational outcomes increase exponentially when educators reflect the language and culture of their students.^{xix} Therefore, for improved educational outcomes for Native Hawaiian students, we need highly trained Native educators. Our objectives are:

OBJECTIVE 1: 9 staff will receive professional development to improve their abilities to provide Hawaiian and English language STEM instruction and to address the unique needs of Native Hawaiian students in the Hawaiian culture-based educational program. By the end of the project, the staff will attend 90% of all the trainings and events, score at or above proficient on ANA 'ŌLELO^{xx} (Hawaiian language proficiency assessment), produce a culture-based STEM program (18 units), and receive “successful” performance reviews.

OBJECTIVE 2: 26 unduplicated students will consistently demonstrate increased levels of Hawaiian and English language literacy and STEM knowledge. By the end of Year 1, 50% of the students will score at or above proficient in the Hawaii School Readiness Assessment (HSRA) and

ANA 'ŌLELO (Hawaiian language proficiency assessment). 75 % of the students (end of Year 2) and 95% of the students (end of Year 3) will score at or above the assessments.

Deliverables: The project will produce a replicable model for both formal and experiential settings. The team will produce a Hawaiian culture-based STEM program for students PreK-3 (18 educational units and a teacher's guide), a parent activities companion (18 home activities), and educational materials (18 hands-on educational items). The program will be in both Hawaiian and English.

The professional development will result in highly knowledgeable staff, who can translate the Hawaiian and Western STEM into an actionable educational program. (Absolute Priority/C: Needs in fields or disciplines in which Native Hawaiians are underemployed). The trained team will be able to provide instruction in the Hawaiian language (Absolute Priority/D: The use of the Hawaiian language in instruction). As Kūlaniākea trains its staff, educational partners, and other educators in the state, the project will create a realistic pathways for Native Hawaiian teachers to obtaining necessary traditional and Western STEM knowledge and skills to address the needs of Native Hawaiian students (Competitive Preference Priority 2: Fostering Flexible and Affordable Paths to Obtaining Knowledge and Skills).

The project will address bilingual literacy and STEM education for Native Hawaiian students in PreK-3, the population, which is at a high risk of educational under attainment. (Absolute Priority/A: Beginning reading and literacy among students in kindergarten through third grade and Absolute Priority/B: The needs of at-risk children and youth). The developed culture-based STEM program will reach at least 36,000 students, ages 3-18, during the project period statewide (See Letters of Commitment) and will be available to the general public beyond the

project period (Competitive Preference Priority 1: Promoting Science, Technology, Engineering, or Math Education, with a Particular Focus on Computer Science)

This project was designed to successfully address the identified needs and gaps in the current educational settings. Kūlaniākea has been implementing a pilot for three years with proven success and is confident that the design is appropriate and will successfully address the needs of Native Hawaiians and identified priorities of the federal opportunity.

Rational & Logic Model

Based on the decades of research on STEM education^{xxi} and Native Hawaiian Education^{xxii}, best practices, and previously successful Hawaiian culture-based STEM projects, the team created a logic model for this project (See Appendix A: Logic Model).

Our teachers and administrators have different levels of Hawaiian language proficiency (beginners to native speakers), teaching certification, and educational attainment (Associate to Master degrees). The project will provide professional development opportunities to bring all providers' baseline to the same level and to prepare the current school staff to address the unique and complex needs of Native Hawaiian students. The project team will receive professional development a year (64 hours of cultural trainings, college courses, sailing/voyaging practicum) in order to learn innovative ways to incorporate STEM and literacy.

Over three years, the team will produce a rigorous culturally-, linguistically-, and age-appropriate STEM curriculum, which will consist of 18 educational units. Each educational unit will contain a lesson plan for PreK-Grade 3 (for teachers/formal setting), a home activity (parents/informal setting), and an educational material (hands-on toy or apparatus). The cultural practitioners and master canoe builder will support the staff in the production of the educational materials. Each lesson plan will contain science content, vocabulary, sentence patterns, concepts,

exercises, and activities for each language and developmental level (preschool, kindergarten, grades 1 through 3). Even though it's only one lesson plan, participants of all levels will be able to cover the same topic, but at a different degree of depths. Each participant will be able to grow from the beginning to the advanced level within the same lesson plan. Such a design makes it easier to implement a lesson plan with a group of students, while providing individualized learning.

The curriculum will cover STEM skills and knowledge in English and Hawaiian languages (vocabulary, texts, songs, legends, traditions), geography (maps, compass, directions, continents, bodies of water, calculating distances), agriculture and botany/ethnobotany (identification of native and invasive plants, use of plants for food, health, clothing, ropes, food preservation), health and wellness (traditional and modern knowledge on diet and exercise, cultural healing traditions, e.g., lomi - massage), astronomy (identification of stars and constellations, ancient star navigation, lunar and solar phases, calendar), oceanography (identification of winds, ocean currents, swells, ocean conditions, ocean landmarks), meteorology (wind, precipitation, clouds, weather conditions, and weather prediction), zoology (native and invasive species, identification of animals, migratory and sedentary patterns), and engineering and construction (choosing materials and tools, measurements, building a canoe). The curriculum will combine the traditional Hawaiian STEM content and modern mathematics, science, technology, and engineering notions, utilizing hands-on activities in the classroom and on an actual sailing canoe.

The students will receive classroom instructions and participate in outdoor learning once a month at Kaiona Beach/Waimānalo. They will engage in new lesson plans/curriculum through the duration of the grants, both in outdoor and classroom environments. Parents will receive trainings, tools, and additional support to use STEM vocabulary and topics in everyday life. The project will

continuously evaluate the curriculum and its delivery, based on the teachers' and partners' experiences in their instruction.

Besides pilot-testing the new program with our students, our educational partners will provide content input and pilot-test the units with students (PreK-12) at their locations in different language instruction modes (English with Hawaiian vocabulary, immersion Hawaiian, dual English and Hawaiian) with students of different ages. Pilot-testing with different types of educational partners will support the program and teacher's manual to be replicable and adaptable to any educational setting: public schools with English instruction, Hawaiian immersion schools, and dual-language schools. Once the curriculum is developed and pilot-tested, the staff will train educators from other schools on its implementation. Teachers and staff will attend and present at school fairs, meetings, and conferences to learn best practices and share the curriculum and implementation process with other schools in Hawai'i and the United States.

At the end of the project, a replicable model of culture-based STEM education, implementation methodology, and educational materials will be available to the public, charter/immersion, and other educational schools and agencies. Additional outputs include: 26 students will demonstrate improved academic performance in literacy and STEM. The broad coverage would allow a child to enter any other school and be prepared to continue their STEM education. 50 parents and family members will receive training on how to support their children's STEM and language learning. 9 staff will be trained in the Hawaiian language and STEM, instruction and delivery. They, in turn, will reach out to other Native Hawaiian schools and agencies to disseminate and implement the curriculum. Our three partners will also reach at least 36,013 children, ages 5-18. Therefore, there will be a total of 36,039 children receiving the

curriculum content. The existing partnership and new connections will ensure broader implementation of the project.

The project's outputs will be the foundation for the following outcomes:

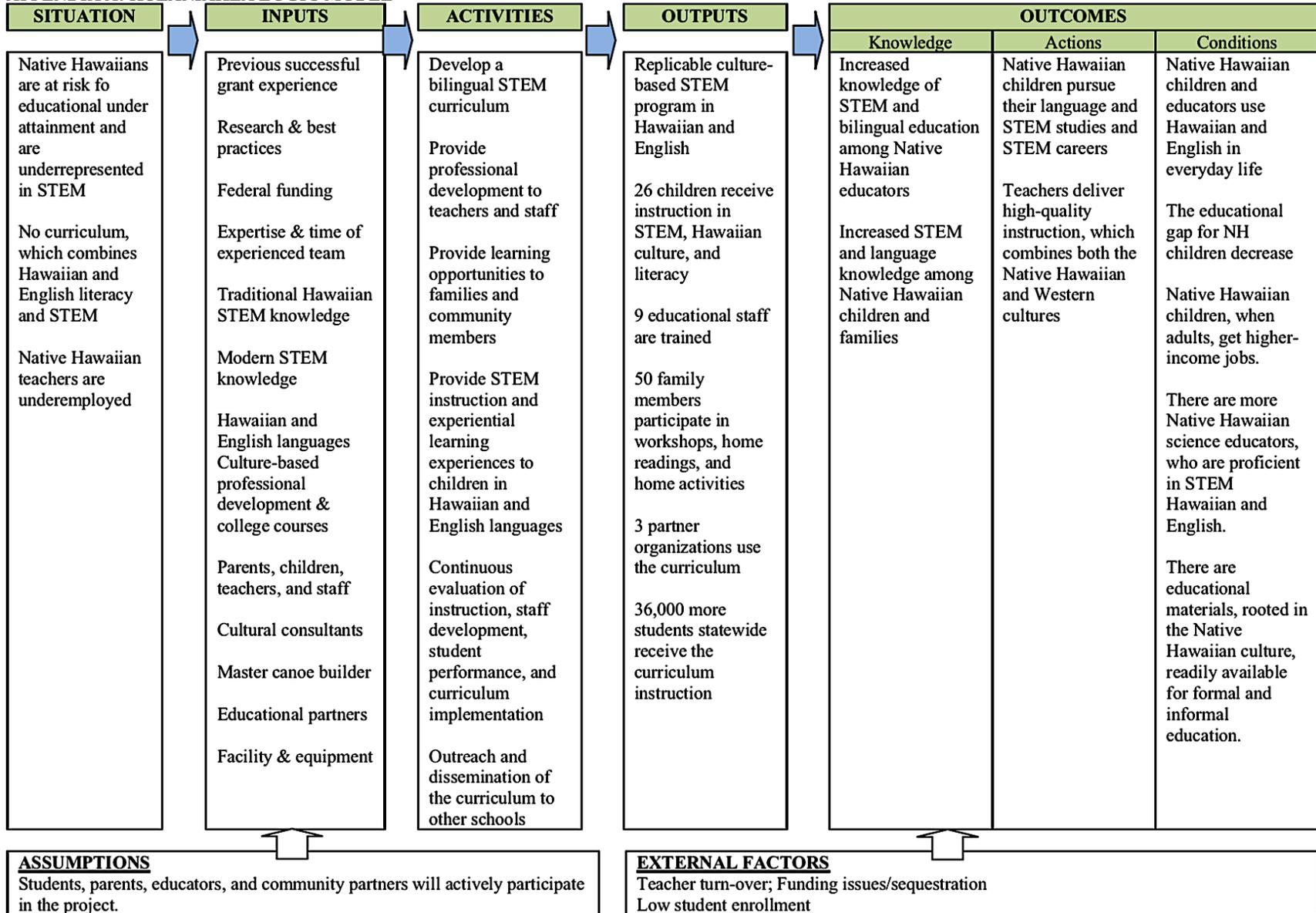
- As staff receives professional development, their knowledge of the content areas and teaching improve, which will result in a rich and stimulating school environment, instruction, quality interaction with children, and children's increased performance.^{xxiii} Professional development and positive teaching experience will increase the number of highly-trained Native Hawaiian educators, providing quality educational experiences to Native Hawaiian children.
- The proposed curriculum will ensure language-, culture-, and science-rich environment, which will support the student's knowledge, interest in, and academic performance in the Hawaiian and English languages and STEM. As children's academic performance increases, so would their ability to use Hawaiian daily and desire to pursue further STEM studies and careers, which provide steadier and higher-income.^{xxiv}
- Broad dissemination and implementation of the program would increase the availability of educational materials and opportunities for Native Hawaiian students to receive a quality education in STEM.

(c) Quality of project services

Equal Access and Treatment for Eligible Project Participants/Members of Underrepresented Groups

In carrying out its educational mission, Kūlaniākea ensures to the fullest extent possible equitable access to, participation in, and appropriate educational opportunities for individuals served. Our activities, programs, and services are accessible to all teachers, students, and other program beneficiaries with special needs, allowing them to participate fully in the projects.

APPENDIX A: KŪLANIĀKEA LOGIC MODEL



Kūlaniākea does not discriminate on the basis of age, color, religion, creed, disability, marital status, veteran status, socio-economic status, national origin, race, gender or sexual orientation or any other federally or state protected class in its education and research programs, or its services and activities. It provides reasonable and appropriate accommodations to meet the learning and evaluation needs of a diverse group of students, staff, community members, and other participants. Kūlaniākea operates at an ADA-accessible facility.

Kūlaniākea ensures equitable access by providing information, outreach, and marketing materials in Hawaiian and English to attract those, not likely to participate in the project, to become active, specifically in our rural area. Kūlaniākea uses all available types of advertisement media (print, radio, TV, online, banners, in-person meetings) to reach people through their preferred means of information gathering and promote participation in any and all programs.

All families, who wish to enroll their child(ren), are provided information about all operations and welcomed to observe the school activities to decide whether it's the right environment for their child. The family handbook provides information on open-door policy to manage any inquiry or complaint, financial assistance, and childhood services through other community and state organizations.

Children are not pre-screened before enrollment. However, the school collects information on race, gender, age, language, medical and development conditions of children to meet all federal and state requirements, to determine whether the organization provides equitable access and services to diverse population, and to ensure enrollment and participation by members of special populations in numbers that mirror numbers in the general population.

Children are provided with an individualized and customized learning environment, regardless of any ability/disability. Teachers are trained to assess each child's progress along with

early childhood developmental milestones and provide additional support to overcome challenges or barriers. If a child is experiencing a more complex issue or disabilities, Kūlaniākea advises parents to contact their physician for further testing and medical consult and other social and community services, which can provide more in-depth services to families. Lessons are presented through mixed methods – visual, tactile/hands-on, oral, etc. This way, students with any disability or difficulty, can receive the instruction. Staff conducts both qualitative and quantitative assessments in order to have a more accurate assessment, support each child's growth, and provide all necessary educational resources. As each child develops at his/her own pace, no judgment is made based solely on the school assessments. Those assessments are used for support purposes only - additional teaching time and resources, parental counseling and decision-making, etc.

Staff is updated and trained on all state and federal regulations and how the organization plans to implement them to deliver quality services in the community. They are notified of available online and in-person trainings to increase their knowledge and skills, which in turn, results in better quality services to all children, especially children with disabilities or developmental difficulties.

Up-to-Date Research and Practice

Kūlaniākea's educational model is a result of the staff's extensive academic and applied research. It is rooted in the Hawaiian Culture-Based Education (HCBE). Prior research in 2008^{xxv} and 2017^{xxvi} showed that the HCBE

Native Hawaiian students in culture-based schools score higher on math and reading standardized tests than their counterparts in mainstream public schools, and have higher graduation rates.^{xxvii} Culture-based education decreases the under-representation of Native students in the STEM pipeline through

science education. Students with high academic achievement and literacy in their native language have a tendency towards higher academic achievement and literacy development in English.^{xxviii}

One of the significant features of the HCBE is integrated learning through multidisciplinary methodology in multiple settings. It combines literacy, history, arts, and STEM in both formal and informal settings^{xxix}. It is similar to the current STEAM approach, which is an innovative way to break silos between cultures and content areas^{xxx}. Reviews of STEAM + literacy educational models show success in increasing knowledge and skills in science, vocabulary, writing, reading comprehension, and communication.^{xxxi} Science and literacy share highly complementary and sometimes identical learning goals, cognitive processes, and discourse practices, as literacy activities support the acquisition of science concepts and inquiry skills, while inquiry science serves as a compelling context for literacy development. This approach will combine literacy, Hawaiian culture, and STEM, as they won't be taught as separate subjects.

Our students also learn basic words and phrases from related Austronesian languages, , Tahitian, Samoan, and Rarotongan^{xxxii}. It allows students to learn similar roots and patterns in multiple languages and the ability to figure out vocabulary and sentence patterns in even unrelated languages, something which is used for coding and decoding in cryptology and computational linguistics. This methodology has been successfully used by Cherokee, Choctaw, Lakota, Meskwaki, Mohawk, Comanche, Tlingit, Hopi, Cree, Crow, Comanche, Hopi, Meskwaki, and Navajo peoples, collectively known as Code Talkers, during the WWII. Their linguistic work has changed the course of the war and the use of coding within social and computer sciences^{xxxiii}.

By using the culture, arts, and traditional crafts, the HCBE teaches scientific framework, computational thinking, and computer science without actually utilizing computers or electronic devices. For example, students learn new language (words, sentences, songs), geography,

meteorology, botany, and mathematics through traditional weaving^{xxxiv}. All of the above reinforces multiple data, codes, patterns, and algorithms (weather, sentence and vocabulary, and mathematical/coding patterns) through a customary hands-on activity.

This approach is supported by the recent award-winning educational practices in computer science and coding to children from PreK to Grade 3 in the Scandinavian countries^{xxxv}. There, children learn science, computational thinking, analytics, and coding through games, arts, languages, poetry, musical instruments, outdoor play, dancing, and knitting^{xxxvi}. Only starting in Grade 4, students use computers to write software/code^{xxxvii}. Such an approach is crucial as the American Pediatric Association has recently recommended limited amount of screen time for preschool/kindergarten-age children^{xxxviii}.

Through our work, these elements have been proven appropriate and applicable to the educational context and needs in Hawai'i. The research studies of Native Hawaiian^{xxxix}, American Indian/First Nation^{xl}, and other minority students^{xli} provide evidence that the approach and methodology reflect up-to-date knowledge from research and effective practices. Kūlaniākea has been implementing this program for two years, and is confident that together these elements will successfully address the identified gaps and needs and ensure the quality of the project.

Impacts of Services on the Recipients

Kulaniākea's goal is to create a STEM program to broaden the participation of Native Hawaiians in STEM education and workforce. The organization is confident that it will positively impact all participants of this 3-year project. The most significant impact of this project is that it plans to address the educational disparities of Native Hawaiians where they start – early childhood and elementary education. Research indicates that the achievement gap for Native Hawaiian

students starts at preschool^{xlii} and widens through middle and high school into college-level education, employment, and income level.^{xliii} Therefore, efforts should begin at the pre-K level.

High-quality early childhood education is essential, as it is one of the most efficient mechanisms to counteract multiple socio-economic barriers and create long-lasting positive impacts for several generations^{xliv}. Such programs generate from \$1.75^{xlv} to \$17.07^{xlvi} in benefits for every dollar invested in social and economic societal benefits for up to three decades. Culture-based education has proven to be the most optimal in increasing educational (language, culture), professional gains (income, economic mobility)^{xlvii}, and overall wellbeing for Native Hawaiian families^{xlviii}, which, in turn, addresses both social and economic issues in Native communities.

Increased knowledge of STEM and Hawaiian language can also provide long-term economic mobility. Last year the U.S. Navy announced that it will switch to training on voyaging and navigation without any instrumentation due to the high risk of hacking into navigation computer systems^{xlix}, the same system^l Kūlanīākea will be teaching to the students. Last year the Hawaiian Airlines implemented a Hawaiian language certification program for employees, which improves their professional mobility^{li}.

Kūlanīākea's project also addresses the current and future population needs in the state. Hawaiian children under the age of 5 are the fastest-growing segment of the state population. By 2040, Native Hawaiians will be predominantly under the age of 25^{lii}. Such demographic change will create a higher demand for culturally-appropriate education in order to provide equitable access and educational growth for Native Hawaiian students and educators within this decade.

After the program is developed and pilot-tested, our project has the potential to reach many Native Hawaiian and non-Native Hawaiian students and change the educational practices, thus increasing engagement and participation of students in STEM education. The theoretical and

practical application of the HCBE has been adopted by the Hawai‘i Department of Education^{liii}, Kamehameha Schools, and the University of Hawai‘i as a foundation for their educational Native Hawaiian programming. Therefore, our project, its methodology and deliverables, will have a high rate of acceptance and replication across Hawai‘i.

Overall, the increase in Native Hawaiian language and culture proficiency will support the short- and long-term social and economic impacts to the recipients and educational system.

(d) Quality of project personnel

Equity-based Organizational Employment Practices

Native Hawaiians experience greater barriers in entering the field of education (both teaching and educational administration) due to actual or perceived lack of skills and knowledge. The employment of trained and qualified Native Hawaiian teachers is integral to Kūlaniākea's operations. Kūlaniākea made a planned effort to recruit the Native Hawaiian Board of Directors and staff. Our Board and staff also represent the segments of the general population in disability, gender identity, age, etc. The Board and management work on creating and implementing culturally-appropriate internal policies and procedures to lower or eliminate the barriers for Native Hawaiians to enter teaching and educational administration field.

Kūlaniākea ensures to the fullest extent possible equitable access to, participation in, and employment for Native Hawaiian candidates. We provide reasonable and appropriate accommodations to meet the needs of candidates and employees. The organization conducts recruitment through mainstream and Hawaiian-language media (radio, TV, newspapers, email, etc.) in English and Hawaiian. Kūlaniākea provides clear and transparent job announcements and job descriptions, which indicate minimum requirements and salary offered. These requirements

are in line with the state licensing regulations and the latest findings on measures to ensure equity-based hiring and onboarding procedures^{liv}.

Educational underachievement is a significant barrier to Native Hawaiian employment. Kūlaniākea focuses its annual performance review on each teacher's professional development and growth; pays for educational courses to close gaps in theoretical knowledge; provides internal mentorship/professional development to all teachers in order to support growth in practical teaching skills; regularly organizes workshops and trainings with Native Hawaiian cultural practitioners to gain the traditional STEM knowledge; and offers competitive salaries (based on years of experience, educational level, and merit) and benefits. Under the proposed project, the team will also take a college-level course on early childhood education, Hawaiian language, and other professional development classes in order to provide high-quality instruction to our students.

This project will include Project Director (0.5 FTE), Evaluator (0.3 FTE), Curriculum Manager (0.2 FTE), Preschool Lead Teacher (0.8 FTE), two Preschool Teacher Assistant (0.5 FTE), Material Designer (0.65FTE), Media Manager (0.4FTE) and Project Coordinator (0.5 FTE). Our team brings together their skills and over 60 years of experience (Hawaiian language, cultural practices, Native Hawaiian education, STEM, lifeguarding, paddling/sailing, grant and project management, and evaluation, etc.) to ensure the success of this project. The current core staff has experience working on similar Native Hawaiian projects and a solid understanding of the grant requirements, federal compliance and reporting. As Kūlaniākea has been developing culturally appropriate organizational processes, policies, and procedures, it is confident in attracting and retaining quality Native Hawaiian teachers/personnel.

Quality of Key Project Personnel

Project Director (Pd): [REDACTED] has over 25 years of experience in educational leadership and management, Indigenous/Native Hawaiian education, curriculum development, performance, and evaluation. [REDACTED] started as a Teacher Assistant at the ‘Aha Pūnana Leo, Hawaiian language nest schools, grew professionally to become a school director, and learned every aspect of the Native educational system and process. She is a subject matter expert, a cultural practitioner of hula and kapa (traditional cloth-making), and a respected leader/elder in the community. She is a Native Hawaiian speaker with an extensive understanding of language and cultural learning across different ages and abilities. She has developed learning materials, trained cohorts of Native Hawaiian teachers, and graduated many Native Hawaiian students.

She has successfully managed three federal multi-year educational grants from the U.S. Department of Education/Native Hawaiian Education (one active award #S362A170051 and two closed awards - #S362A120031 and #S362A120046) and one active award from the U.S. Department of Health and Human Services/Administration for Native Americans (#90NL0633). She has also managed private awards (Harold Castle Foundation, Kamehameha Schools, Pettus Foundation, Samuel N. and Mary Castle Foundation, etc.) and a federal subaward (USDOE #S362A110016-11A). Under her leadership, the awards were in full compliance, and achieving objectives and milestones on time and within the budget.

She will be the lead on culturally- and linguistically-appropriate educational programming and responsible for the overall grant and fiscal compliance. She will conduct management, monitoring, evaluation, planning, and coordination of staff, contractors, resources, tasks, and activities. She will provide supervision and individualized professional development to the staff

on curriculum development and implementation, bilingual instruction, outreach, and parent education. The PD will also coordinate the work with the partners and cultural practitioners.

(e) Quality of the management plan

Management Plan/Timeline

All project activities will start on October 1, 2020, and end September 30th, 2023. The project will follow the school calendar year. An academic year starts in August in Hawai'i. All hiring is formalized before the school year. All student, parent, and staff pre-assessments also take place in August-September of each year, before the beginning of the project.

There are several customary activities, which repeat every year due to the cyclical nature of an educational process. In Quarter 1, Project Director (PD) procure all necessary materials and supplies for the year ahead. The PD, Curriculum Manager (CM), Material Designer (MD), Teacher/Teacher Assistants (T/Tas), Media Manager (MM), Project Coordinator (PC), and Evaluator (EV) establish and refresh the monitoring and evaluation system (indicators, tools, timeline, etc.) in order to track, document, and continuously evaluate the project performance. The team prepares the pre- and post-assessment for students and teachers. PD, CM, and EV establish protocols for teacher observation and evaluation.

During Quarter 4, the school conducts a two-day STEM family camp, in which parents and students participate in hands-on cultural activities. They are observed by the project team (ED, CM, Ts, TAs, MM, and EV) in order to provide language and content support and document students' development. The team also conducts post-assessment and Ho'ike (graduation ceremony) for children. PD, CM, and EV conduct the staff's evaluation.

Year 1: In Quarter 1, the team will meet with the partners to finalize the scope of work for Year 1 and develop a detailed professional development plan for each project member.

In Quarter 2-4, the staff will receive 64 hours of professional development and cultural trainings (the cultural practitioners and college course). The team and the practitioners will also work on developing a detailed Scope and Sequence, which will determine the sequence of educational units and corresponding outcomes. The project team and cultural practitioners/partners will discuss the students' learning goals for each year and the whole project overall. Each assessment will be updated with the appropriate information.

In quarter 3-4, the team will produce 6 educational units (lesson plans, educational material, home activities), which will be pilot-tested with students at school and home. The team and master canoe builder will also work on making educational materials, e.g., 3-part cards, a construction kit of Hawaiian, Tahitian, and Maori canoes, star boxes, matching disks of moon phases and constellations, flashcards and labels in Hawaiian and English, cloud viewfinder, etc.

In Year 1, the educational focus will be on developing scientific inquiry skills among children: practical field skills (swimming, walking, digging, expedition preparations), observation, data collection, description, recording (drawing, picture taking, basic writing, etc.), and communication (verbal and non-verbal). During the whole year, Q1-Q4, our students will receive instruction in the classroom and on a sailing canoe (twice a month). Kūlaniākea will use previous and newly developed educational units daily.

PD will provide professional development and support to the teaching team on how to incorporate the content into the lesson plans at the age-appropriate level and how to unfold the lesson plans in the outdoor and classroom environments throughout the year. The team will also meet with parents monthly and provide them with home activities and foundational understanding of the STEM in these activities. MM will video-tape the program implementation for both

evaluation of the teachers' performance and future dissemination purposes. Videos and educational units will be posted on our website and social media.

During Quarter 4, the team will pull together the educational units and feedback from partners and consultants to update the Scope and Sequence, assessments, and teachers' notes, and to establish the more precise scope of work for Year 2. The project team will produce a Year 1 project evaluation report.

Milestones Year 1: 64 hours of professional development and cultural trainings; 3 cultural consultants/practitioners, Scope & Sequence, evaluation and assessment structure for the project (teachers, students), assessment baseline for the students and teacher's professional development, 6 educational units produced (lesson plans, educational materials, home activities, videos of delivering the educational content); one STEM family camp, Year 1 project evaluation.

Year 2: In Quarter 1, the project team will meet with the cultural practitioners and partners to finalize the scope of work for Year 2 and refine a detailed professional development plan for each project member. The teaching staff will also conduct Year 2 pre-assessment for students and performance goal setting for the staff.

In Quarter 1-4, the staff will receive professional development and cultural trainings (the cultural practitioners and college course), a total of 64 hours. The team will continue pilot-testing the previously developed 6 educational units. They will also develop another set of 6 educational units and pilot-test them. The team and master canoe builder will work on making educational materials for all partner organizations, e.g., construction kits of Hawaiian, New Zealand, and Tahitian canoes, traditional star compasses, star maps, storyboards, islands and channels puzzles, matching cards for birds and fishes, etc.

In Year 2, the educational units will focus on patterns: interpretation of multiple data points

over time, recognizing and identifying patterns, interpreting data into patterns, combining different patterns, plotting/planning, summarizing, synthesizing, and reporting on findings (written, verbal, non-verbal communication skills in Hawaiian and English). During the whole year, Q1-Q4, our students will receive instruction in the classroom and on a sailing canoe (twice a month). The 12 developed educational units will be implemented and distributed to educational partners for pilot-testing and implementation in their educational settings throughout the year. MM will video-tape the program implementation for both evaluation and future dissemination purposes. Videos and educational units will be posted on our website and social media.

PD will provide professional development and support to the teaching team on how to incorporate the content into the lesson plans at the age-appropriate level and how to unfold the lesson plans in the outdoor and classroom environments throughout the year. The team will meet with parents monthly and provide them with home activities.

During Quarter 4, the team will pull together the educational units and all feedback from partners and consultants in order to update the Scope and Sequence, assessments, and teachers' notes, and to establish the more precise scope of work for Year 3. The project team will produce a Year 2 project evaluation report.

Milestones Year 2: 64 hours of professional development and cultural trainings; 3 cultural consultants/practitioners, 6 additional educational units produced (lesson plans, educational materials, home activities, videos of delivering the educational content); 3 educational partners, pilot-testing the educational units; one STEM family camp, and Year 2 project evaluation.

Year 3: In Quarter 1, the project team will meet with the educational partners to finalize the pilot-testing timeline for Year 3. The teaching staff will also conduct Year 3 pre-assessment for students and performance goal setting for the staff.

In Quarter 1-4, the staff will continue pilot-testing the previously developed educational units and will develop another set of 6 educational units and pilot-test them. The team and master canoe builder will work on making educational materials enough for pilot-testing by all organizations, e.g., updated construction kits of Hawaiian, New Zealand, and Tahitian canoes, star maps for the three countries, storyboards, specific to Hawai'i, New Zealand, and Tahiti, islands and channels puzzles, matching cards for birds and fishes, flashcards and labels in Tahitian, Hawaiian, and Maori, etc.

Year 3 will focus on actual voyaging and navigation: planning an outing biweekly and voyages within the Polynesian triangle, based on available historical by Polynesians and current voyages by the Polynesian Voyaging Society, weather and ocean information, oral and written accounts, and socio-political relationships with the destination islands. During this year, the students will be able to demonstrate their fundamental coding skills (sequencing, branching, looping) in practice. The planning for the voyage requires a sequence of preparation steps: first, you chart a voyaging a course, then you determine the most optimal weather conditions (tide, wind, starts, etc.) for sailing; after that, depending on the season and number of people, you pack necessary items and calculate the amount of food for the voyage (Sequencing). Even though the preparation steps might be similar, each voyage might present a different set of challenges, which will require some deviations from the original plan (Branching). With several voyages planned and executed, and all challenges and differences accounted for, the students will be able to repeat and replicate their voyages in the classroom and at the beach (Looping). During the whole year, Q1-Q4, our students will receive instruction in the classroom and on a sailing canoe (twice a month). The 6 newly developed educational units will be implemented in the classroom and distributed to educational partners for pilot-testing and implementation in their educational

settings throughout the year. MM will video-tape the project implementation for both evaluation and future dissemination purposes.

PD will provide professional development and support to the teaching team on how to incorporate the content into the lesson plans at the age-appropriate level and how to unfold the lesson plans in the outdoor and classroom environments throughout the year. The team will meet with parents monthly and provide them with home activities and STEM content.

During Year 3, the team will conduct an outreach/dissemination campaign. The school will hold monthly tours and semi-annual open houses for the community. Videos and educational units will be posted on our website and social media. Kūlaniākea will share its methodology and deliverables at public events and community trainings (4). The organization participates in many community events (Canoe Festival, annual School Fair, Children's Expo, Honolulu Chapter for Home Schooling Fair, Ola Ka Ī), where we put a booth and interact with the general public. For this project, Kūlaniākea will also present the results of the project at the Native Hawaiian Educational Council convention, at the National Indian Education Association

(Year 3, locations and dates TBD).

During Quarter 4, the project team will pull together the educational units and all feedback from partners and consultants in order to update the Scope and Sequence, assessments, and teachers' ' notes, and to finalize the whole program. The project team will produce a Year 3 project evaluation report.

Milestones Year 3: 9 culturally and professionally trained staff; 26 unduplicated students, meeting and exceeding the benchmarks; 50 parents/family members, supporting their children, 3 educational partners, pilot-testing the educational units; 18 educational units fully tested (lesson

plans, educational materials, home activities, videos of delivering the educational content); one STEM family camp, and 4 training and outreach events in the community.

Deliverables: a replicable model of Native Hawaiian STEM education, which will be easy to adapt and adopt to both formal and informal settings.

Kūlaniākea conducted extensive preliminary planning and outlined the implementation plan in detail to have a clear roadmap for this project. The implementation plan accounts for all activities, responsibilities, timelines, and milestones for each objective for the full project period.

Ensuring High-Quality Products and Services

The previous grants' experiences allowed Kūlaniākea to establish systems and infrastructure to ensure that the staff produces quality materials, and the project is implemented on time and within the budget.

Programmatic Quality: The staff dedicates time to collection and analyses of data. Project performance meetings are held on a regular (weekly and monthly) basis, during which team members update on the school progress and discuss impacts, if any, on overall organizational activities. The frequency of internal meetings and established channels of communication have allowed the organization to deal with unanticipated events and outcomes more efficiently, before they become a more significant issue, and meet deadlines and progress benchmarks on time.

Operations Quality: Kūlaniākea has all the necessary internal controls and financial policies and procedures in place. All policies and procedures, including separation of responsibilities, procurement, and contract monitoring, give the organization checks and balances in the financial and programmatic management.

Kūlaniākea's financial systems support timely tracking and production of monthly, quarterly, and annual financial reports. The current financial system allows the organization to

maintain internal controls to ensure compliance with Federal financial management requirements and cost principles. The project team follows the approved grant agreements, narratives, work plans, school calendar, budgets, and all other necessary documentation in order to provide oversight of federal funds, submit all required financial and programmatic reports, and deliver the project on time and within the budget. The organization has the internal capacity to manage multiple projects and contractors, collect data, aggregate reports, and submit them to funders.

Overall, the organization has the internal capacity to ensure the production and delivery of high-quality programs, services, and materials.

External Review Process: Kūlaniākea seeks feedback, input, and pilot-testing of all our curriculum and materials from both educational partners and cultural practitioners. Our programs can't be only culturally-relevant; they also need to be age/developmentally-appropriate and practical for educational delivery. Such an approach requires a close collaboration of multiple multidisciplinary partners. (See Letters of Commitment)

For this particular project, our collaborators, Na Kalai Wa'a, Kaulakalana, Polynesian Voyaging Society, and Ka Ohana Holokai, will serve as cultural advisors and trainers. They are experienced educators and practitioners in voyaging and navigation. They are also recognized experts and cultural practitioners of voyaging and navigation.

Na Kalai Wa'a (NKW) will provide professional development to the project staff on traditional voyaging and navigation in English, feedback and input on the incorporation of the knowledge into the curriculum, and serve as a member of the advisory board. Kaulakalana will provide professional development on the current practices of Polynesian voyaging across the globe (both Atlantic and Pacific Oceans and how to use the traditional knowledge in an unknown environment, e.g., the Atlantic Ocean) in the Hawaiian language. Ka Ohana Holokai will provide

voyaging practicum to the project staff and provide feedback and input on the incorporation of the voyaging and navigation into the curriculum. They will also provide their double-hull canoe for children and adults to learn and practice their voyaging skills for 96 hours a year, a total of about 288 hours for the project period. The Polynesian Voyaging Society sailed worldwide using only traditional voyaging and navigational practices. They also have broad educational experience to 34,000-54,000 students a year.

Our educational partners, Polynesian Voyaging Society, Nā Kālai Wa‘a, and Windward Community College, will pilot-test our program (units and educational materials) with their students, at least 36,000 children of all ages across the state. They work with children and adults of all ages and all literacy skills, both in Hawaiian and English. They teach in formal (classroom) and informal (outdoors and family centers) settings. Our partnerships support us in the production of high-quality content, which is relevant and practical in implementation.

Overall, the organization has a management plan (timeline, milestones/deliverables) and mechanisms to ensure that the project produces high-quality products and services on this project.

(f) Quality of the project evaluation

Rigorous monitoring and evaluation are fundamental to the project. The evaluation plan was developed while designing the project to ensure that the evaluation supports the efforts to measure the achievement of the project outcomes.

Evaluator: Gauhar Nguyen has over 15 years of grant and project management and evaluation experience as a Grants and Compliance manager with international teams on many multi-million, multi-year federally-funded grants (Russia, Mozambique, East Timor, Sudan, Cote D’Ivoire, Columbia, Marshall Islands, etc.). She served as an external community facilitator and evaluator on several Native-led projects on education, agriculture/aquaculture, and social enterprise

development (State of Hawai'i Department of Education, Kamehameha Schools, etc.). She holds a B.A. in Education and M.A. in Education (Curriculum Studies and Statistics), which focused on evaluating language curricula. She will lead the evaluation and monitoring. She will collaborate with the team in collecting, analyzing, and producing periodic reports that evaluate the effectiveness of the project in reaching its goals and objectives.

Formative Evaluation is critical in addressing the learning process of all participants and providing feedback to the project team on its work.

OBJECTIVE 1: 9 staff will receive professional development to improve their abilities to provide Hawaiian and English language STEM instruction and to address the unique needs of Native Hawaiian students in the Hawaiian culture-based educational program. By the end of the project, the staff will attend 90% of all the trainings and events, score at or above proficient on ANA 'ŌLELO (Hawaiian language proficiency assessment), produce a culture-based STEM program (18 units), and receive “successful” performance reviews.

Every year, nine staff will demonstrate their professional development through participation in internal and external trainings on the Hawaiian language and culture (college transcripts, # and hours of workshops and trainings attended), production and pilot-testing of educational units and materials, presenting the project at local and national conferences, and conducting outreach events to other schools. Annually, the project members will also demonstrate their professional development through regular classroom instructions and parent education, as observed by the PD and CM, and documented through students' and parents' assessments, and bi-annual performance reviews and ANA 'ŌLELO assessment.

OBJECTIVE 2: 26 unduplicated students will consistently demonstrate increased levels of Hawaiian and English language literacy and STEM knowledge. By the end of Year 1, 50% of the

students will score at or above proficient in the Hawaii School Readiness Assessment (HSRA) and ANA 'ŌLELO (Hawaiian language proficiency assessment). 75 % of the students (end of Year 2) and 95% of the students (end of Year 3) will score at or above the assessments.

HSRA will measure five developmental domains: (a) approaches to learning, (b) literacy and mathematical concepts and skills, (c) school behaviors and skills, (d) social-emotional behaviors, and (e) physical well-being of the toddler and primary classes (students up to age 6). ANA 'ŌLELO (Hawaiian language proficiency assessment) will reflect the mastery of the Hawaiian language and STEM content. Both assessment tools will be administered pre- and post-instruction at the beginning and end of a year to document the students' progress. The teaching team will also conduct continuous students' observation, based on the Hawaiian Indigenous Education Rubric^{iv}, to monitor the actual language usage in real-life situations, and the students' cognitive, social, emotional, and physical well-being. HSSRA and ANA 'ŌLELO assessments meet the Government Performance and Results Act of 1993 (GPRA) performance measures.

Data on the children, teachers, and parents will be analyzed together in order to determine factors, contributing to both positive and negative impacts, e.g., formal or experiential setting, the language of instruction, length of instruction, age of children, etc. The project will document structure, activities, and any variations from the proposed activities, and solutions in order to create a replicable model and provide the best practices in addressing project implementation challenges. The partner organizations will also pilot-test the curriculum modules and provide feedback on how well the curriculum meets the needs of Native Hawaiian students (K-12) and produces the desired outcomes. By analyzing the curriculum implementation in different educational settings (classroom, nature and canoe camp, mixed environment, Hawaiian only, dual, English with

Hawaiian vocabulary), the project will be able to determine which strategies and best practices apply to which situation. The formative evaluation will be compiled annually.

Summative Evaluation will document to what extent the team implemented all project components as proposed on time and within budget, to what extent the objectives were met, and whether the project produced the stated outcomes. Outputs, project timeline, budget and actual expenses, meeting notes, teachers' notes, classroom observations, performance evaluations, and students' and adults' assessment results will be collected quarterly and analyzed.

Our summative evaluation will happen at the end of each year and at the end of the project. Annual summative reports will be supported with the formative evaluation data. Annual summative reports will allow us to assess our progress towards the final evaluation of the whole project and how the model impacts the overall performance of the participants. The analysis of the project would allow to establish feasibility, document activities, and costs, and provide a blueprint on implementing, sustaining, and scaling this program at other schools, and identification of factors that contributed to failure or success.

Kūlaniākea uses multiple methods and tools of evaluation: quantitative (standardized pre- and post-assessments, descriptive statistics) and qualitative (observations, meetings, discussion, feedback, document reviews) data collection and analysis; Western and Indigenous decolonial research methodologies^{lvi}, and Community Participatory research to create an extra level of accountability and ethical research behavior in relationship to our community^{lvii, lviii}. Our evaluation plan ensures that we collect meaningful, valid, and reliable performance data regularly in order to demonstrate outcomes and impacts. The organization has been using this approach successfully on several federal awards and is confident that it will provide valid and reliable performance data to showcase the achievement of the results.