

HELU HAWAI‘I: A CRITICAL ETHNOMATHEMATICS PERSPECTIVE

Eōmailani Keonaonalikookalehua Kukahiko

This article is a recapturing of our Hawaiian numerical mo‘olelo through historical Hawaiian language texts. While curricular trends in Hawai‘i’s public educational settings (and nationwide) aim to normalize a narrow, standardized Western worldview of mathematics education, this critical ethnomathematic interrogation of foundational Hawaiian language texts engages new perspectives and reaffirms our genealogical connections to rich cultural traditions of Helu Hawai‘i.

CORRESPONDENCE MAY BE SENT TO:

Eōmailani Keonaonalikookalehua Kukahiko, College of Education
University of Hawai‘i at Mānoa
1767 University Avenue, EH 221, Honolulu, Hawai‘i 96822
Email: eomai@hawaii.edu

Hūlili: Multidisciplinary Research on Hawaiian Well-Being Vol. 11, No. 2 (2019)
Copyright © 2019 by Kamehameha Schools.

HO‘OLAUNA

Living in Waimānalo, “God’s Country,” I was fortunate to have grown up in one of the most beautiful places in the world. After school each day I would walk down to the beach, go for a swim, a walk, or even just contemplate the view from the Ko‘olau mountain ridgeline to the horizon. As I began to study the Hawaiian language, I learned the concept of one hānau. Through this imagery I immediately connected back to the literal sands of my birth in Waimānalo, and I understood more deeply the love that one can feel for an ancestral home. Learning ‘ōlelo Hawai‘i has given me the ability to articulate, through language, the connection I feel with this ‘āina.

Scholarship for me always begins with my connection back to this place, the ‘āina, and the people who have shaped my experiences as a Hawaiian, a mother, a teacher, and a scholar. I have sought to find connectedness for myself, my children, and my students, integrating our traditional mo‘olelo into everything I teach. I initially struggled, however, with mathematical understandings born of this place and assigning quantity to value that is reflective of aloha ‘āina. The mathematics curriculum that I was taught, and was now teaching, seemed so disconnected from my place and from the ‘ōlelo that imbued increased understandings through relationship. This dissonance allowed me to explore deeper understandings of math through our ‘ike kupuna.

Dr. Noenoe Silva (2017) describes a similar process through the work of two erudite nineteenth-century writers, Joseph Kanepuu and Joseph Poepoe: “They needed to set down in print their engagement with the intellectual traditions of ancestors of previous eras and they needed to analyze their world, and thereby not only describe what Hawaiian intellectual life is or was, but to live it” (p. 3). At times, I have been called upon to reengage and redefine what these traditions look like through a shifting lens of decolonization. Early in this process I struggled, both as a learner and a teacher, to reconnect to knowledge that was inherent, yet unfamiliar. I worried that by teaching the “universal” mathematics curriculum I had become complicit in replicating Western narratives that did not acknowledge Hawaiians as polymaths themselves, thereby necessitating a need to adopt, translate, then regurgitate American textbook curriculum. Unknowingly, however, I also began to employ “defamiliarizing analytic tools” (Kaomea 2003), trying to “peel back familiar, dominant appearances and expose previously silenced and potentially disturbing accounts of the oppressive conditions in our schools”

(p. 14). I began to deconstruct (or, at that point, just talk back to) mainstream educational discourse.

While my original interest in Hawaiian mathematics focused on designing curriculum for my fourth-grade immersion students, my desire to increase student access to educational experiences that were reflective of larger social movements toward self-determination—and to recognize Hawai'i's unique geographic location at the center of the Pacific—led me to a deeper exploration of Helu Hawai'i.

UA LEHULEHU A MANOMANO KA 'IKENA A KA HAWAI'I

“Great and numerous is the knowledge of Hawaiians”—Four hundred thousand and four thousand are the knowledges of the Hawaiians (Pukui, 1983, #2814). This famous 'ōlelo no'eau asserts, through quantification, the multitudinous intelligences of the Hawaiian people. This article utilizes Hawaiian language, education, and mathematics research to explore one facet of these knowledges, namely kuana'ike helu kahiko, a quantifiable, mathematical Hawaiian worldview.

The terms helu kahiko (traditional counting systems) and helu hou (new counting systems) are central to my exploration of the dichotomy of cultural and mathematics views. My use of these terms is based on Hawaiian scholar Joseph H. Kanepuu's account of Mataio Kekuanaoa, ali'i and president of the Board of Education from 1860 through 1868, who was admonishing a Hawaiian man for his failure to calculate properly the number of huli kalo through our Hawaiian counting system: “Heaha ko oukou mea i haalele ai i ka helu kahiko o ko kakou aina, kainoa e hana no oukou ma ka helu hou, a e hana no ma ka helu kahiko? Why have you [folks] abandoned the usage of the traditional counting systems of our land? I presumed you would engage in the new counting systems and you would continue in the old counting systems” (Kanepuu, 1867, p. 3, my translation).

This dichotomy of both helu kahiko and helu hou, as highlighted by Kanepuu, reflects historical understandings of the hegemony of Western ideologies inherent within early formal education in Hawai'i. It also serves as a continual warning that while embracing new knowledges, mathematical and otherwise, we must not forget our own Hawaiian knowledge traditions.

This paper provides a critical ethnomathematical analysis of a range of texts translated into the Hawaiian language for formal instructional use in Hawai‘i’s early educational systems, from the arrival of the missionaries until the turn of the twentieth century. I then contrast these texts with two other Hawaiian language texts, which present uniquely Hawaiian worldviews that are more congruent with cultural, religious, linguistic, and educational traditions of the same time period. These frameworks and comparisons contribute to a deeper understanding of Hawaiian knowledge systems that are inherently mathematical by interrogating early sources of discursive teaching practices and American cultural hegemony that are still present in contemporary mathematics curriculum and instruction.

Missionaries in the 1800s gave their Christian message prominence over actual mathematics content, sometimes explicitly and sometimes subliminally. Because traditional Hawaiian knowledge includes customs and ways of knowing that are antithetical to Christian beliefs and practices, it is not surprising that these texts would not only be dismissive of Hawaiian knowledge but also denigrate non-Christian erudition and practices.

As a second-language learner of ‘ōlelo Hawai‘i, I am keenly aware of my Hawaiian language limitations, as well as the English-dominant worldview I bring to my language acquisition. As such, I have included images of the Hawaiian texts here so that any reader may co-construct possible complementary and/or alternative understandings of all included passages for possible use in educational mathematics instruction. This approach is similar to Kuwada’s theory on “embedded” translation (2013), where multiple translators are involved in creating meaning of a single text for translation. “Embedded” curriculum and, by extension, professional development, proposes that students, teachers, and parents, as stakeholders of Hawaiian education, should be invested in cocreating and engaging curricular materials for classroom use. This approach is in direct opposition to curricular movements that, as Kelly (2009) asserts, aim to “teacher proof” curriculum. This idea of teacher proofing is evident in many classrooms where teachers are required to use prescribed texts to teach students. These texts do not simply serve as a guide but go as far as to script teaching and demand “fidelity” to the standardized curriculum.

Educational curricular trends continue to acculturate Hawaiian and other diverse populations within schools by omitting their contributions to a collective body of legitimized knowledge while simultaneously privileging a Western colonial perspective of educational success. As will be seen in the texts I examine,

early students of missionaries were expected to connect with foreign cultural markers that were outside of their ancestral understandings. These markers are clearly linked to the colonizing influences in Hawai'i's current public education curriculum.

While research exists that promotes diverse mathematics curricula rooted in both culture and social justice (D'Ambrosio, 1999; Gutstein & Peterson, 2006; Kaomea, 2011; Moses & Cobb, 2002; Greer, Mukhopadhyay, Powell, & Nelson-Barber, 2009; Wager & Stinson, 2012), many schools, administrators, and teachers in Hawai'i may be reluctant to implement this progressive but divergent approach to mathematics education due to the culture of accountability and educational reform measures in Hawai'i's schools. The Hawai'i Department of Education, in addition to the majority of educational departments in the continental United States, adopted the Common Core State Standards, which focus on preparing all of Hawai'i's students to be college and career ready in the core subjects of English language literacy and mathematics.

Rather than narrowing our focus to language arts and mathematics alone, educators should be looking to a broader definition of mathematics curricula. Engaging in interdisciplinary and multicultural understandings of what comprehensive mathematics curricula could look like in Hawai'i's schools, especially for kula kaiapuni Hawai'i and Hawaiian-focused charter schools, allows educators and learners to reimagine possibilities for contemporary Hawaiian educational reform by looking to Hawaiian wisdoms first, then expanding our knowledge to include US national curricula and beyond.

An example of the contrast between *helu hou* and *helu kahiko* is reflected in the transliterated words *haneli* (hundred) and *kaukani* (thousand), which were created to accommodate a base-ten numerical system. Traditionally, *lau* (four hundred) and *mano* (four thousand) would have been used to quantify these larger numbers. While both systems utilize a compatible proportion in their comparative values, the Hawaiian counting system also reflects a unique acknowledgment of place through an understanding of gathering resources in fours.¹

Looking first to Hawaiian knowledge systems is especially important for Hawaiian children who may have a difficult time connecting in meaningful ways to mathematics as currently taught, requiring remediation upon entering tertiary institutions and becoming "disproportionately underrepresented" in math fields (Kaomea, 2011, p. 291; Hammond, Wilson, & Barros, 2011).

For many learners who have gone through conventional Western education, the idea that mathematics is so closely linked to culture may be incongruous. Like language, however, mathematical constructions are inextricably linked to the way we view the world. As Greer et al. (2009) explain, “Mathematics is comprised of a diversity of practices that make it as historically, culturally, socially, and politically situated as any other human activity. It is grounded in human interactions with the environment and with one another” (p. 1).

Expanding on their work, I draw upon Mukhopadhyay, Powell, and Frankenstein’s (2009) ethnomathematical “challenges” (p. 71) framework to guide my “interrogation” (Vasques, Harste, & Albers, 2010) of early missionary texts. With this understanding, the purposes of a comprehensive ethnomathematics education should focus on:

1. Challenging the Eurocentric narrative in mathematics
2. Challenging what counts as knowledge in school mathematics
3. Challenging the disconnections between mathematics education and social and political change (Mukhopadhyay et al., 2009, p. 72)

It may be limiting to dictate which text addresses which element of the aforementioned ethnomathematics theoretical framework. Instead, I engage in more than one challenge at a time. In the first challenge, I assert that for too long Hawaiian knowledge has been null in Hawai‘i’s curricular reform, especially in mathematics. In the second challenge, I argue that Hawaiian knowledge should be included at the core of classroom instruction, thereby rejecting the dominant Eurocentric narrative while simultaneously challenging what counts as knowledge in school mathematics. In the third challenge, I recognize that a prescribed mathematical curriculum includes high-stakes testing and is intimately linked to neoliberal political change.

These challenges have provided me with a mathematical-power framework to interrogate my experiences critically as a student within a Western model of learning mathematics. Having sensed a disconnect from my cultural context, I use my own experiences and linguistic learning to explore Hawaiian language texts that have been utilized in mathematics education. This framework also describes the potential for students and teachers to develop critical numerical agency through our own mo‘olelo ‘ōlelo Hawai‘i.

Utilizing children's home culture should be the foundation for meaningful learning experiences in mathematics. This cultural foundation can then be used to scaffold entry at different points in learning math to support student success. This revisioning of mathematics education may help students become more engaged in higher-level mathematics. With regard to restricted access, or the inability for many students to engage in higher-level mathematics, Gutstein (2005) declares that "the broader issues of opportunity to learn, access, and equity all demand that marginalized students get the chance to develop mathematical power" (p. 30).

For mathematics education, developing this mathematical power means that we can no longer rely solely on Hawaiian translations of English mathematics textbooks as the sole source to provide cultural curricular experiences for our students. We must begin with our own mo'olelo. As Hawaiian historian S. M. Kamakau stated, "He makemake ko'u e pololei ka moolelo o ko'u one hanau, aole na ka malihini e a'o iau i ka moolelo o ko'u lahui, na'u e ao aku i ka moolelo i ka malihini" (Kuwada, 2009). Like Kekuanaoa, Kamakau's charge reminds us that it is our responsibility to hold fast to the stories and histories of this place, serving as the repository for all our mo'olelo.

MO'OLELO MAKEMAKIKA

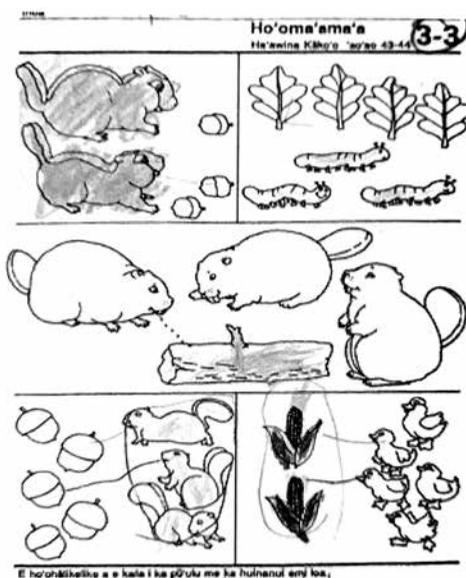
Acknowledging and using stories and histories of Hawai'i in mathematics education is critical to empowering the future potential of Hawai'i's learners. If Hawaiian students are unaware of their own mathematical traditions and prowess, they may be less inclined to see themselves as a part of this mathematical tradition and therefore less motivated to engage in this learning in future careers.

Unlike the earlier introduced concept of helu hou to describe foreign counting systems, the very transliteration for "mathematics," makemakika—which means "dead mosquito"—references a dead, alien insect species ascribed to having carried lethal diseases upon its unintended introduction into Hawai'i. As such, the word makemakika is conspicuously disconnected to traditional thought and origin as expressed in Hawaiian language. This term also infers that Hawaiians do not have our own mathematical traditions to build upon when, in fact, Hawaiians do have a way to express our mathematical traditions through helu kahiko, as well as foreign

traditions through *helu hou*. This would-be erasure of Hawaiian understandings is especially dangerous when considering that the Hawaiian language itself is being used to supplant sources of traditional knowledge.

This is the space where we must engage a lens of critical literacy for analysis of school curricula. Critical literacy posits that while engaging in text from a critical perspective, we become “agents of texts rather than victims of text” (Vasques et al., 2010, p. 266). For me, an introduction to the critique of hegemonic mathematics translation occurred when my son, who was just five years old at the time, brought home an assignment from his *papa mālaa’o*. For my child, along with many Hawaiian children, school has become an entryway to reengage learning through the medium of Hawaiian language. As translation has provided the vast majority of mathematics curriculum for use in the classroom, the cultural worldviews that are presented run counter to the larger decolonial messages that are common in *kula kaiapuni* settings. The seemingly innocuous one-to-one correspondence lesson using basic enumeration represented by unrecognizable animals (fig. 1) is a recurring expedient: the appropriation of existing curricula utilizing foreign images and illustrations ironically implies that Hawai’i and Hawaiians are bereft. My son’s homework assignment shows how American, or colonial ideology necessitates translation of “Western” texts as primary resources for mathematics curriculum development in Hawai’i.

FIGURE 1. One-to-one correspondence assignment



Should impressionable second-language learners of Hawaiian be taught that squirrels (kiulela), beavers ('ilio hulu pāpale), and chipmunks (no translation) are effective for establishing a one-to-one correspondence within a Hawaiian context? Should I then, as a mother and educator, dismiss our own cultural landscape to normalize foreign curricular hegemony?

Maaka, Au, Lefcourt, and Bogac (2001) retell the experience of another child in a Hawai'i public school classroom during math instruction. While struggling to understand what a raccoon was, he became overly frustrated and, because he did not know what a raccoon was, he did not know how to subtract them. The authors explain, "For many children of diverse cultural and linguistic backgrounds, school learning consists of a series of 'raccoon-like' experiences. The disparities between teachers' assumptions about what children know and what children *actually* know are one aspect of the mismatch between the culture of the school and culture of the home" (pp. 342–343). With prompting, this child may have been encouraged to distinguish between subtraction, a skill that he utilizes daily, and the raccoon, an animal that he had never seen, much less experienced. The curriculum "mismatch" occurring in classrooms reinforces the idea that enumeration is not part of Hawaiian cultural practice and causes students to lose confidence or become indifferent to their in-school learning experience.

Gee (1990), whose experiences are primarily with non-Hawaiian cultures that have been negatively impacted by the disconnects between home and school discursive practices (discourses), warns of the dangers of complicity for young children whose educational experiences clash with their personal cultural values: "In becoming a full member of school Discourses...children run the risk of becoming complicit with values that denigrate and damage their home-based Discourse and identity" (p. 4). Schools have long been a colonial battleground and, while they now serve as sites of language and cultural renewal, educators must ensure that formal educational experiences at school align with the cultural values we instill in our children.

Emphasizing the importance of relevant and deep primary mathematical learning experiences for young children, the National Council of Teachers of Mathematics currently takes the following position on early childhood mathematics, stressing the importance of connections to children's experience in the world: "Teachers should guide children in seeing connections of ideas within mathematics as well as with other subjects, developing their mathematical knowledge throughout the day and across the curriculum. They must encourage children to communicate,

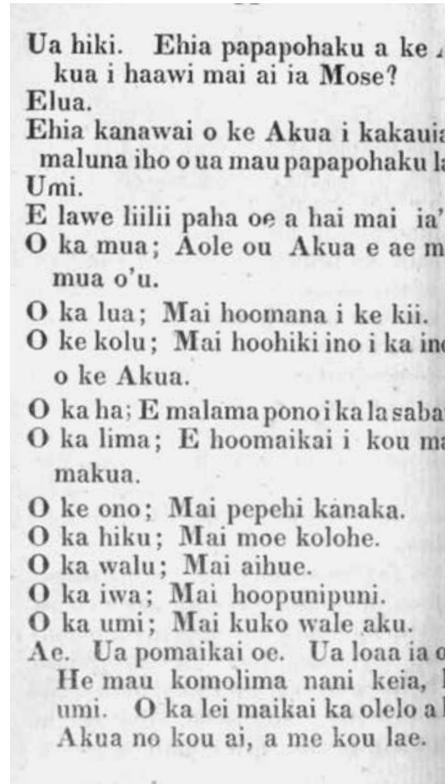
explaining their thinking as they interact with important mathematics in deep and sustained ways” (2013). Hawaiian students, without knowledge or context of the animals they are asked to count, are not likely to interact with mathematics in deep and sustained ways. While I believe that students should be well-versed in “important”—also referred to as “Western,” “academic,” and/or “classical” (each term is problematic)—mathematics, typical mathematics classroom instruction is primarily focused on a narrow understanding of mathematics that is severed from familiar experiences. The National Council of Teachers of Mathematics encourages educators to guide children to see connections. Yet, children will not readily make these connections if they are unfamiliar with the contexts of the translated math curriculum.

HE AUPUNI PALAPALA (MUA)

Kauikeaouli (Kamehameha III) boasted about the importance of an educated, literate nation when he claimed, “He aupuni palapala ko‘u.” Hawaiians readily embraced Western literacy in both English and Hawaiian with fervor. Unfortunately, these palapala often provided literacy experiences that demeaned deep Hawaiian belief systems. The following text (fig. 2) is an example of a basic text used in early missionary instruction.

One possible translation of the book title is, *A Beginning Primer for Children: So That They Will Be Learned in Adolescence*. An alternative translation, however, is *Beginning Scriptures for Children: So That They Will Be Civilized in Their Adolescence*. Implicit in both translations is the idea of conversion—the first to a state of theretofore unknown enlightenment, and the second to a state of anointed civility—conferring elevated status to the missionary authors/instigators and an opposing, counter, and lesser status to their pupils. Problematic in this math text is the explicit Christian indoctrination imbedded within the counting lesson. Ka‘aihue (2010) suggests the following about early missionary-driven education: “Biblical ideology presented Christian propaganda to replace those histories, deliberately devaluing Hawaiian knowledge.... Through the process of being ‘civilized’ the children learn to separate themselves from their ‘dark’ pasts” (p. 79). The missionaries’ Ten Commandments-based instruction placed children at discord with their deeply held traditions and customs, their primary sources of learning.

FIGURE 2. Nā kānāwai a Mose



Source: Na Misionari, 1835, title page and p. 14.

This missionary text utilizes counting to encourage children to embrace Christian teachings. The lesson then goes on to recite each of the Ten Commandments, asking students to submit to the supremacy of a single God as a one-to-one correspondence lesson. Each commandment carried with it a moral compass for how children should behave if they were to be “maikai.”

Take, for example, this passage from the same primer (Na Misionari, 1835), which follows a basic counting lesson: “E helu pono mai oe i akaka. Akahi, alua, akolu, aha, alima, aono, ahiku, awalua, aiwa, umi” (p. 13). It continues by asking students to enumerate responses for a lesson about Moses and the Ten Commandments (fig. 2). The lesson begins, “Ehia papapohaku a ke Akua i haawi mai ai ia Mose? Elua. Ehia kanawai o ke Akua i kakauia maluna iho o ua mau papapohaku la? Umi” (p. 14). The lesson prompts each child to recite each commandment, several in

direct conflict with Hawaiian cultural practices. Each lesson, and each scripture, is designed to bring children into the light of a civilized and humanized, essentially Christian way of thinking and behaving.

In this analysis, I focus my attention on the first, second, and fourth commandments—those that most obviously conflict with Hawaiian cultural values and lend themselves to this mathematical discussion. The first commandment states, “O ka mua; Aole ou Akua e ae mai ma mua o‘u” (Thou shalt have no other Gods), while the second commandment states, “O ka lua; Mai hoomana i ke kii” (Do not worship graven images or likenesses). Hawaiians ho‘omana many Gods. *Kini akua*, the term often used to refer to the multitude of Hawaiian Gods, reminds us that this number may have been upward of forty thousand. Gutmanis (1983) remarks not only on the multitude of Hawaiian Gods but also on their purpose: “Many are the [G]ods of Hawaii. So numerous are they that in ancient times they were called *na pu‘a* [sic] *ali‘i ‘uhane*, or the chiefly flock of spirits. These [G]ods are to be found not only in the heavens but also in the plants, birds, fish, rocks, and everything of nature, a [G]od for every need of man” (p. 3). It can be argued that Hawaiians had little difficulty embracing Christianity as a new faith, because “Ke Akua” was the addition of just one more God to the Hawaiian pantheon. Through these commandments, and other biblical doctrine, however, we are shown that Christianity does not reciprocate the same philosophy and acceptance of Hawaiian polytheism. Similarly, scholar Davida Malo discusses the personal nature of Hawaiian ho‘omana, describing the difference of ho‘omana for each person at each station in life: “He kuae ka hoomana ana a na kanaka ma Hawaii nei i na [a] kua kii, no ka mea, he akua okoa ko kekahi kanaka, okoa loa ko kekahi kanaka, pela no na [a]lii kane, he okoa ke akua o kahi alii, me ke akua o kahi alii, aole like pu” (Malo, 1996, p. 61). For Hawaiians who reconnect to culture through ho‘omana Hawai‘i, there is not a prescribed approach for religious worship, as Gods were and will continue to be different for each kanaka.

The fourth commandment states, “O ka ha; E malama pono i ka la sabati.” The need to “malama” the sabbath necessitated a shift from the anahulu (ten-day cycle) to the contemporary, seven-day week. The sabbath day, Lāpule (prayer day), became the day when Hawaiians were encouraged to attend formal church services rather than recognize the ceremonies connected with the moon phases named for Hawaiian Gods. This erasure allowed early missionaries to recalibrate the Hawaiian calendar and adopt the Gregorian calendar instead (fig. 3). Though the months were promoted using Hawaiian words (Ianuali, Pepeluali, Malaki, ‘Apelila,

Mei, Iune, Iulai, 'Aukake, Kepakemapa, 'Okakopa, Nowemapa, and Kēkēmapa), this calendar shift is a significant marker in the insinuation of a dominant time system implemented to further foreign ways of knowing in Hawai'i.

FIGURE 3. Calendar used in kula kaiapuni classroom with Westernized Hawaiian days



Source: Papa 1, Kula Kaiapuni.

In efforts to resource kula kaiapuni with curriculum for classroom use, a second-language majority has created and translated materials that embody characteristics of the dominant language. NeSmith (2005) refers to these speakers as “neo” Hawaiian language speakers who “are changing the way Hawaiian language (and by extension, Hawaiian cultural values) is understood, expressed and embodied. This change is transforming Hawaiian identity” (p. 3). Surprisingly, three decades after establishing Ka Papahana Kaiapuni, we continue to primarily utilize the Gregorian calendar, even though most educators today are well aware that its doctrinal and historical origins undermine contemporary Hawaiian educational movements to decolonize our educational systems. On the surface, utilization of Hawaiian(ized) words and months suggests a Hawaiian worldview; in truth it is a narrow translation of the Western calendar. Translation of English language

resources without regard for their cultural affinity with Hawaiian children can be particularly insidious as it merely masks the transmission of Western ideas disguised in our mother tongue.

In locating the genesis of epistemological paradigm shifts, we begin by tracing back to the following calendar (fig. 4). In addition to the religious underpinnings of traditional calendars, the “Alemanaka Kristiano” was an attempt to reconcile the traditional Hawaiian calendar (based on the moon) with the Christian model for counting the days and months of the year (based on the sun).

This calendar had “evolved” to exclude the complexity of the lunar malama Hawai‘i, as well as the individual moon phase names, replacing them with transliterated days. Thus, the calendar was a mechanism to transition students into “enlightened” educational experiences devoid of Hawaiian moons named for Hawaiian Gods.

Hawaiian tradition maintains that progenitors of the Hawaiian people are Gods who also embody life forms and forces of nature: Papahānaumoku, who gave birth to our islands, who in turn birthed man; Hāloa, the first man; and Hāloa’s stillborn brother, Hāloanakalaukapalili, the first kalo plant. There is an unbroken genealogical relationship between Native Hawaiians, our akua, and our ‘āina. These unbroken familial ties are central to the well-being and very existence of Native Hawaiians. Efforts to sever our genealogical relationships to our akua threaten our ability to connect to our ancestors and their names through times, spaces, and places. Smith (1999), in expanding on Freire’s work, speaks to the importance of naming and renaming: “By ‘naming the world’ people name their realities. For Indigenous communities, many realities can only be found in the indigenous language; the concepts which are self-evident in the indigenous language can never be captured by another language” (pp. 157–158). The challenging nature of translating English concepts into Hawaiian—and even Hawaiian concepts into more modern versions of acculturated Hawaiian thought—is evident when viewing the multiple realities and understanding of time in Hawai‘i.

Mo‘okū‘auhau is another mathematical concept that cannot be fully articulated through translation. Hawaiian genealogy scholar (Kame‘eleihiwa, 1992) reminds us of the critical role mo‘okū‘auhau plays for Hawaiians: “Genealogies are the Hawaiian concept of time, and they order the space around us. Hawaiian genealogies are the histories of our people” (p. 19). This “calendar,” recounted through mo‘okū‘auhau, explicates the relationship of each element of the natural environment to time and space (fig. 5).

FIGURE 4. Christian calendar

ALEMANAKA KRISTIANO.					
Malama 5. Mei, 1865. La 31.					
MAH. HAPALUA MUA		LA.	MAH. HAPALUA HOPE		LA.
MAHINA POEPOE		2	MAHINA HOU		17
		10			24
LA O KA MALAMA.	LA O KA HEBEDONA.		PUKA MAIKA LA.	NAPOO KA LA.	NAPOO KA MAHINA.
1	Monede	Po 1	5 29	6 24	Kaka.
2	Tusede	Po 2	5 29	6 25	0 24
3	Wenede	Po 3	5 28	6 25	1 4
4	Tarede	Po 4	5 28	6 26	1 41
5	Feraide	Po 5	5 27	6 26	2 17
6	Satude	Po 6	5 26	6 26	2 53
7	D	SAB.	5 26	6 27	3 28
8	Monede	Po 1	5 25	6 27	4 5
9	Tusede	Po 2	5 25	6 28	4 43
10	Wenede	Po 3	5 24	6 28	P. mai,
11	Tarede	Po 4	5 24	6 29	7 37
12	Feraide	Po 5	5 23	6 29	8 30
13	Satude	Po 6	5 23	6 30	9 21
14	D	SAB.	5 22	6 30	10 11
15	Monede	Po 1	5 22	6 31	10 59
16	Tusede	Po 2	5 22	6 31	11 45
17	Wenede	Po 3	5 21	6 32	Kaka.
18	Tarede	Po 4	5 21	6 32	0 30
19	Feraide	Po 5	5 20	6 33	1 13
20	Satude	Po 6	5 20	6 33	1 58
21	D	SAB.	5 20	6 33	2 43
22	Monede	Po 1	5 20	6 34	3 29
23	Tusede	Po 2	5 19	6 34	4 20
24	Wende	Po 3	5 19	6 35	Napoo.
25	Tarede	Po 4	5 19	6 35	7 34
26	Feraide	Po 5	5 19	6 35	8 39
27	Satude	Po 6	5 19	6 36	9 30
28	D	SAB.	5 18	6 36	10 17
29	Monede	Po 1	5 18	6 37	10 59
30	Tusede	Po 2	5 18	6 37	11 39
31	Wenede	Po 3	5 18	6 37	Kaka.

Source: Alemanaka Kristiano, 1865, p. 4.

FIGURE 5. Genealogy of Hawaiian months

Ka hanau ana o na Malama.
O ke Ao ke kane o ka Po ka wahine, hanao mai ka laua o Kapaakuokahonua he keiki kane. O Kapaakuokahonua ke kane, o Kapakuokahonua ka wahine, hanao mai ka laua o Kalaniiluna he keiki kane no, o Kalaniiluna ke kane, o Kahonua i lalo ka wahine, hanao mai ka laua, o Kekuahiwi he keiki kane no, o Kekuahiwi ke kane, o Kekuahiwi ka wahine, hanao ka laua o Kapapalimulimu he keiki kane no, o Kapapalimulimu ke kane, o Kapapalimulimu ka wahine, hanao ka laua o Kehaia he keiki kane no, o Kehaia ke kane

o Moanaheka ka wahine, hanao ka laua o Hinaiama ka wahine, hanao o Ikuwa he keiki kane no, o Ikuwa ke kane, o Kapohakoelele ka wahine hanao o Welehu he kane no, o Welehu ke kane, o Kaiehu ka wahine, hanao ka laua, o Makalii he kane, o Makalii ke kane, o Haliima ka wahine, hanao ka laua o Kaelo he kane, o Kaelo ke kane, o Kahonoku ka wahine, hanao mai ka laua o Kaula he kane no, o Kaula ke kane, o Kaulawena ka wahine hanao ka laua o Nana he kane no, o Nana ke kane, o Kahueloiki ka wahine, hanao ka laua o Welo he kane no, o Welo ke kane, o Kahueloiki ka wahine, hanao mai ka laua, o Ikiiki o Ikiiki ke kane, o Malamahelele ka wahine, hanao ka laua o Kaaona o Kaaona ke kane, o Malamahelele ka wahine, hanao ka laua, o Hinaiama he kane, o Hinaiama ke kane, o Kapuliokalani ka wahine, hanao ka laua o Hilinaha a me Hilinaha he mau mahoe laua, oia ka hanau ana o na malama, a ma keia mookuaupau, ka hea ia ana o na inoa o na malama, ma ka belu a keia pae Aina, i ka wa kahiko a hiki i keia wa.

Source: Manuokekula, 1861, p. 4.

While recounting the creation of Ao, a man, and Pō, a woman, this genealogy continues on to connect light and dark with the names of the malama Hawai'i. As Manuokekula (1861) states, "O Kekaiakea ke kane o Moanakea ka wahine, hanau ka laua o Hinaaimalama ka wahine, hanau o Ikuwa he keiki kane no" (p. 4). Ikuwa is then celebrated as the first Hawaiian month, and all following months are his lineal male descendants. This mo'olelo also serves as a perpetual reminder that daily calendar math routines based on Western concepts will never fully encapsulate the powerful nature of genealogical relationships for Hawaiians to foundational elements of our universe.

HELU HAWAI'I

The next example of numerical displacement and paradigm shift is taken from the Hawaiian newspaper *Ke Au Okoa*.

FIGURE 6. Hawaiian counting system

4	kahi	hookahi	ia	kauna	4
10	kauna	"	"	kaau	40
10	kaau	"	"	lau	400
10	lau	"	"	mano	4,000
10	mano	"	"	kini	40,000
10	kini	"	"	lehu	400,000
10	lehu	"	"	poina	4,000,000
10	poina	"	"	nalowale	40,000,000
A pela aku no e like me ka mea i ma.							

Source: Kanepuu, 1867, p. 3.

Many historical Hawaiian newspapers, printed as early as 1867, warned of the dangers of forgetting Hawaiian cultural traditions, and Kanepuu (1867) specifically addresses this problem: “E nana i ka papa o na mea ana i hoike ia ma ka helu kamalii, ma na pepa a mamua iho o ka papa hoonui; aole no he hana mau o na kupuna o kakou i ka helu i keia wa e hana ia nei a hiki i ka haneri, a pela aku. Ma ka hale makeke ma Ulakoheo, a ma na wahi kuai ia e ae a pau, ke maa mau nei no na kanaka, wahine a me na kamalii ma ka helu i hoikeia maluna ae nei” (p. 3). While Kanepuu contends that men, women, and children were all well versed in Ka Helu Hawai’i (fig. 6), an increasingly foreign presence felt a need to manipulate the traditional counting system to accommodate the more widely accepted base-ten number system shown below (fig. 7).

FIGURE 7. Western base-ten system translated into Hawaiian

HE PAPA HELUHELU I NA HUA.

Ke hoike nei keia papa i ke kau ana i na hua helu,
a me ka pii paumi ana o keia hua kela hua mai ka
akau a ka hema.

<p>Na inoa o na wahi e kau ana na huahelu, E hoo- maka ma ka akau, ma na kaahi, a e heluhelu mai a hiki i ka hema.</p>	<p>Na kateriliona. Na haneri teriliona, Na umi teriliona, Na teriliona, Na haneri biliona, Na umi biliona, Na biliona, Na haneri miliona, Na umi miliona, Na miliona, Na haneri tausani, Na umi tausani, Na tausani, Na haneri, Na umi, Na kahi,</p>
<p>Ka helu ana i ke ia puu huahelu, Elima katerili- ona, elua ha- neri me kana- hiku kumama- ono teriliona, me aha haneri kanawalu ku- mamalima bi- liona, me ole haneri iwaka- lua kumamahi- ku miliona, me eiwa hanere umi kumama- kolu tausani, me elima ha- neri a me ka- naha.</p>	<p>5, 2 1 6, 4 0 5, 0 2 1, 9 1 3, 5 4 0</p>

Source: Leonard, 1852, p. 8.

As Bishop (1990) posits, asserting mathematical dominance was part of a “deliberate strategy of acculturation” (p. 53). This acculturation was continuing to occur through a shift from helu kahiko to the helu hou and the base-ten system. The change primed Hawaiians for the economic and monetary systems that would soon be imposed to accommodate trade and other burgeoning commercial activities in Hawai'i. Through the colonization of these counting systems and related structures, foreigners were able to interject values into our mathematical systems to advance their social, political, and economic ends. As Ngugi (1986) expresses, “The real aim of colonialism was to control the people’s wealth: what they produced, how they produced it, and how it was distributed; to control, in other words, the entire realm of the language of real life” (p. 16). This controlling of wealth and natural resources is described by Kamakau (1868) in *Ka Nupepa Kuokoa*, in reference to the insurmountable debt undertaken by the ali'i engaging in Hawai'i's new Westernized economy through the lā'au 'ala (sandalwood) trade.

O ke Dala e hookaa ai o keia aienui, o ka laau Ala. Nolaila, pii nui aku la na 'lii a me na kaukauali'i a me na pua alii a me na aialo a pau o ka Moi a me na 'Lii a me ka poe i hoonohoia poe kalai laau ala, a ua noho kekahi poe makaainana, aole i pii kekahi, aka, ua hoounaunaia na makaainana e halilali na makaainana i ka laau ala i kai o na awa ku moku. O na aialo o na 'lii la poe i noho mau me na kuahiwi i ke lua laau ala, a ua make kekahi oia poe ma na kuahiwi, a ua ku ua puoa i ka nahelehele. O kekahi poe alii no me ko lakou mau ohua kekahi, aole alii noho wale i kai. Ua kapaia ka poe aialo i noho loihi loa ma kuahiwi i ke kua laau ala, he hilaulele, no ka noho loihi loa a loa i ka wi. (p. 1)

The passage describes the ali'i, the kaukauali'i, the pua ali'i, and the 'aialo, along with the maka'āinana, all being reassigned to gather lā'au 'ala. Kamakau describes the devastation and many lives lost to starvation in this capitalist undertaking, which was in direct opposition to traditional subsistence practices. The mission was to educate the indigenous people to enable them to function adequately in the new economy. These capitalist systems introduced disparate views, including the commodification of land and natural resources for profit. American capitalism laid siege not only to Hawai'i lands, but also to the very life ways of Hawai'i's people—ways of regarding space, structure, and change. As we now look to interrupt capitalist systems that are in conflict with Hawaiian subsistence practices, we need to employ “transformative remedies” (Fraser 2000) that rethink the system of production.

‘A‘OLE I PAU

This paper explored and interrogated Hawaiian language texts via worldviews that have been mostly absent in mathematics education in Hawai‘i, being relegated primarily to linguistic rather than numerical resources. While this work of developing *kuana‘ike helu kahiko*, a quantifiable, mathematical Hawaiian worldview, only begins to scratch the surface, it is my hope that other Hawaiian language and mathematical scholars will take up the charge to further embed mathematics curricula that honor this ‘āina and its people. Kaomea (2011) encourages, “If we are to prepare our students to seek sustainable, culturally appropriate solutions to global and societal problems that no one yet knows how to solve—or that no one has seen before—they will need a firm grounding in the accumulated wisdom of our ancestors coupled with excellent creative thinking and mathematical problem-solving skills” (p. 293).

Cultivating mathematical capacity in our children must begin with their sphere of experiences. “O ke kahua ma mua, ma hope ke kūkulu” (Pukui, 1983, #2459). First, the foundation, then the building. To encourage critical thinking skills in mathematics, we must encourage *haumāna* to critique power structures that threaten to eliminate our place as Hawaiians in mathematical *mo‘olelo*. Through ongoing analysis and interrogation of Hawaiian texts, mathematics—a seemingly universal and neutral content area—can be used to challenge Western educational paradigms of discourse that continue to devalue our knowledge base, especially in the wake of occupied, nationalized standards. It is imperative that we have a collective understanding of the origins of foundational texts to ensure that contemporary Hawaiian educational settings do not unwittingly replicate misguided teaching methods entrenched in current educational practices.

We must provide students with knowledge that allows them to participate fully in their global learning environments, while simultaneously acknowledging the evolving understanding that we as contemporary Hawaiians have of our *helu kahiko*. It is in the complexity of mathematical ideas—which showcase the polarity of Hawaiian and Western worldviews—that we experience the beauty and diversity of our culture. An understanding of customary Hawaiian mathematics traditions provides a means to reframe the way we conceptualize mathematics curricula taught in Hawai‘i’s schools, thereby reengineering the possibilities and wonders of our future.

REFERENCES

- Alemanaka Kristiano. (1865, Feberuari 23). *Ka Nupepa Kuokoa*, Vol. 4, No. 8, p. 4. Retrieved from <https://www.papakilodatabase.com/pdnupepa/cgi-bin/pdnupepa?a=p&p=home>
- Bishop, A. (1990). Western mathematics: The secret weapon of cultural imperialism. *Race & Class*, 32(2), 51–65.
- Capps, L. R. (1987). *Houghton Mifflin mathematics level K*. (Hale Kuamo'o, Trans.). Boston, MA: Houghton Mifflin.
- D'Ambrosio, U. (1999). Literacy, mathercy, and technocracy: A trivium for today. *Mathematical Thinking & Learning*, 1(2), 131–153.
- Fraser, N. (2000). Rethinking recognition. *New Left Review*, 3, 107–120.
- Gee, J. P. (1990). *Social linguistics and literacies: Ideologies in discourses* (3rd ed.). London, England: Routledge.
- Greer, B., Mukhopadhyay, S., Powell, A. B., & Nelson-Barber, S. (Eds.). (2009). *Culturally responsive mathematics education*. New York, NY: Routledge.
- Gutmanis, J. (1983). *Na pule kahiko: Ancient Hawaiian prayers*. Honolulu, HI: Editions Limited.
- Gutstein, E. (2005). *Reading and writing the world with mathematics: Toward a pedagogy for social justice* (1st ed.). In M. W. Apple (Ed.), *The Critical Social Thought Series*. New York, NY: Routledge.
- Gutstein, E., & Peterson, B. (Eds.). (2006). *Rethinking mathematics: Teaching social justice by the numbers*. Milwaukee, WI: Rethinking Schools.
- Hammond, O. W., Wilson, M., & Barros, C. (2011). *Comparing the achievement patterns of Native Hawaiian and non-Native Hawaiian grade 8 students in reading and math* (Issues & Answers Report, REL 2012-120). Washington, DC: US Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, Regional Educational Laboratory Pacific. Retrieved from https://ies.ed.gov/ncee/edlabs/regions/pacific/pdf/REL_2012120.pdf
- Ka'aihue, M. (2010). *I ka 'ōlelo no ke ola, i ka 'ōlelo no make: Deconstructing Hawaiian children's literature* (Doctoral dissertation). University of Hawai'i at Mānoa, Honolulu, HI.
- Kamakau, S. M. (1868, Feberuari 1). Ka moololo o na Kamehameha. No. 58. No ka noho alii ana o Liholiho maluna o ke aupuni, a ua kapaia o Kamehameha II. *Ka Nupepa Kuokoa*, Vol. 7, No. 5, p. 1. Retrieved from <https://www.papakilodatabase.com/pdnupepa/cgi-bin/pdnupepa?a=p&p=home>

- Kame'elehiwa, L. (1992). *Native land and foreign desires: Pehea lā e pono ai? How shall we live in harmony?* Honolulu, HI: Bishop Museum Press.
- Kanepuu, J. H. (1867, Ianuari 21). Ka helu Hawaii. *Ke Au Okoa*, Vol. 2, No. 40, p. 3.
Retrieved from http://ulukau.org/collect/nupepa/index/assoc/HASH0107/ac5e4ddc.dir/023_0_002_040_003_01_ful_18670121.pdf
- Kaomea, J. (2003). Reading erasures and making the familiar strange: Defamiliarizing methods for research in formerly colonized and historically oppressed communities. *Educational Researcher*, 32(2), 14–25.
- Kaomea, J. (2011). Hawaiian math for a sustainable future: Envisioning a conceptual framework for rigorous and culturally relevant 21st-century elementary mathematics education. *Hūlili: Multidisciplinary Research on Hawaiian Well-Being*, 7(1), 289–306.
- Kelly, A. V. (2009). *The curriculum: Theory and practice* (6th ed.). London, England: SAGE Publications.
- Kuwada, B. K. (2009). To translate or not to translate: Revising the translating of Hawaiian language texts. *Biography*, 32(1), 54–65.
- Kuwada, B. K. (2013, November). *Hikapalalē, hikapalalē: Historical and contemporary translation in Hawai'i*. Presented at the Mellon-Hawai'i Doctoral Fellowship Program, Keauhou, Hawai'i.
- Leonard, G. (1852). *He huinahelu: Oia ka helunaau me ka kelukakau, i huiia*. Honolulu, HI: Na Misionari Mea Pai. Retrieved from <http://www.ulukau.org/elib/collect/huinahelu/index/assoc/D0.dir/book.pdf>
- Maaka, M. J., Au, K. H., Lefcourt, Y. K., & Bogac, P. (2001). “Raccoon? Wass dat?” Hawaiian preservice teachers reconceptualize culture, literacy, and schooling. In P. R. Schmidt & P. Mosenthal (Eds.), *Reconceptualizing literacy in the new age of multiculturalism and pluralism* (pp. 341–366). Greenwich, CT: Information Age Publishing.
- Malo, D. (1996). *Ka moolelo Hawaii: Hawaiian traditions*. (M. N. Chun, Ed. and Trans.). Honolulu, HI: First People's Productions. (Original work published 1898)
- Manuokekula, G. W. K. (1861, Novemaba 7). Ka hanau ana o na malama. *Ka Hoku o ka Pakipika*, Vol. 1, No. 7, p. 4. Retrieved from <https://www.papakilodatabase.com/pdnupepa/cgi-bin/pdnupepa?a=p&p=home>
- Moses, R. P., & Cobb, C. E. (2002). *Radical equations: Civil rights from Mississippi to the algebra project*. Boston, MA: Beacon Press.
- Mukhopadhyay, S., Powell, A. B., & Frankenstein, M. (2009). An ethnomathematical perspective on culturally responsive mathematics education. In B. Greer, S. Mukhopadhyay, A. B. Powell, & S. Nelson-Barber (Eds.), *Culturally responsive mathematics education* (pp. 65–84). New York, NY: Routledge.

- Na Misionari. (1835). *He palapala mua na na kamalii, e naauao ai i ko lakou wa opiopio* [Lesson book]. Oahu: Na Misionari. Retrieved from <http://www.ulukau.org/elib/collect/palapala/index/assoc/D0.dir/doc8.pdf>
- National Council of Teachers of Mathematics. (2013). What is important in early childhood mathematics? Retrieved from <https://www.nctm.org/Standards-and-Positions/Position-Statements/Mathematics-in-Early-Childhood-Learning/>
- NeSmith, R. K. (2005). Tūtū's Hawaiian and the emergence of a neo-Hawaiian language. *‘Ōiwi: A Native Hawaiian Journal*, 3(1), 1–15.
- Ngugi wa Thiong’o. (1986). *Decolonising the mind: The politics of language in African literature*. Portsmouth, NH: Heinemann.
- Pukui, M. K. (1983). *‘Ōlelo no‘eau: Hawaiian proverbs and poetical sayings*. Honolulu, HI: Bishop Museum Press.
- Pukui, M. K., & Elbert, S. H. (1986). *Hawaiian dictionary*. Honolulu, HI: University of Hawai‘i Press.
- Silva, N. K. (2017). *The power of the steel-tipped pen: Reconstructing Native Hawaiian intellectual history*. Durham, NC: Duke University Press.
- Smith, L. T. (1999). *Decolonizing methodologies: Research and indigenous peoples*. Dunedin, New Zealand: University of Otago Press.
- Vasques, V., Harste, J. C., & Albers, P. (2010). From the personal to the worldwide web: Moving teachers into positions of critical interrogation. In E. A. Baker (Ed.), *The new literacies: Multiple perspectives on research and practice* (pp. 265–284). New York, NY: Guilford Press.
- Wager, A. A., & Stinson, D. W. (Eds.). (2012). *Teaching mathematics for social justice: Conversations with educators*. Reston, VA: National Council of Teachers of Mathematics.

ABOUT THE AUTHOR

Eōmailani Kukahiko is a Native Hawaiian from Waimānalo, O‘ahu, with four children. She is a faculty member in the Curriculum Studies department at the University of Hawai‘i at Mānoa, where her research focuses on Hawaiian language immersion education, teacher preparation, and the integration of Hawaiian culture-based education into STEM, specifically mathematics. She has a BA in Hawaiian studies, an EdB in elementary education, and an EdM and PhD in curriculum and instruction. Prior to her work at the university, she worked for five years as a Hawaiian language immersion teacher.

NOTE

1 Tubers, kalo, and fish are some examples of resources that were counted in fours. The words pākāuna and pāka‘au were used specifically for fours and forties, respectively (Pukui & Elbert, 1986).