

We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,100

Open access books available

149,000

International authors and editors

185M

Downloads

Our authors are among the

154

Countries delivered to

TOP 1%

most cited scientists

12.2%

Contributors from top 500 universities



WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index
in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com



Digital Socio-Technical Innovation and Indigenous Knowledge

Poline Bala, Narayanan Kulathuramaiyer and Tan Chong Eng

Abstract

Scientific research involving remote rural communities is often plagued by a lack of understanding of what constitutes indigenous knowledge. That is, indigenous perspectives, models of representation, and their ways of knowing. Through a long-standing community-university partnership in working with remote and rural communities in the Borneo Malaysian states of Sarawak and Sarawak and the Orang Asli communities in Peninsular Malaysia, we address this concern in presenting directions for shaping digital socio-technical innovation. We highlight the need to adopt a balanced indigenous worldview based on two case studies from past interactions with these indigenous communities to highlight how indigenous knowledge can now become contextualized within contemporary problem-solving scenarios.

Keywords: indigenous knowledge management, indigenous worldview, sustainability oriented socio-technical innovation

1. Introduction

Propelled by developments of industrial revolution 4.0, nations are gearing towards a knowledge-intensive economy. Therefore, optimism towards scientific knowledge and digital-based innovation to drive economic growth is on the rise. However, the roles of indigenous peoples' place-based knowledge, skills, and experiences have largely been overlooked in the expansion of the digital-based framework of technological innovation. This is due to a lack of understanding of what constitutes indigenous knowledge - indigenous perspectives, models of representation, and their ways of knowing. In fact, because of the appearance of incommensurables between the two types of knowledge, in their encounters with each other, indigenous knowledge is often sidelined. This is despite for the untold number of years indigenous knowledge has helped indigenous communities around the globe to stay resilient in the face of complex challenges and diverse adversities. Drawing on two decades of community-university partnerships between Universiti Malaysia Sarawak and five different rural indigenous communities in the Malaysian states of Sarawak and Sabah on the island of Borneo and four remote Orang Asli communities in Peninsular Malaysia, this paper highlights the need to adopt a balanced indigenous worldview in order to ensure that traditional knowledge remains intact in their encounters with other knowledge systems. This paper addresses this concern through a socio-technical system framework, which is a balanced ecosystem whereby technology is embedded and woven, rather than externally imposed, into a social system for a balanced human-machine interaction and the integration of scientific exploratory models in solving complex problems. This requires a

careful co-envisioned and co-designed framework in a participatory manner that benefits the symbiosis between people, the ecosystem, and the environment.

The next section of the chapter provides a brief overview of indigenous knowledge; that is its characteristics and its increased importance in the development agenda framework at different levels: international, national, and communities. It then highlights an emerging barrier between indigenous knowledge and scientific knowledge due to the appearance of incommensurables between the two types of knowledge. The chapter then offers case studies to highlight what are the possibilities of the weaving of these two kinds of knowledge through a socio-technical innovation system. This is followed by a discussion and conclusion to the chapter. It concludes that a socio-technical innovation model, which is a balanced ecosystem where technology is embedded into a social system as an integral knowledge weaving, provides a useful system framework to contextualize indigenous knowledge within contemporary problem-solving scenarios.

2. Literature review

Over the last decade, there is increased awareness that the vast collection of traditional knowledge of indigenous communities holds the key to solve many complex problems. Built over generations through close interaction with natural surroundings and a deep understanding of nature's sociality, indigenous knowledge has helped communities to be resilient, live sustainably, and face global challenges such as climate change.

Due to its significance as a tremendous resource, there have been attempts to include indigenous knowledge to deal with global causes and concerns. A robust example is an effort by James David Wolfensohn, who served as president of the World Bank (1995–2005). In 1998, the World Bank acknowledges that indigenous knowledge “represents an important component of global knowledge” (World Bank, 1998, as cited by [1]). With that, there was a deliberate attempt to shift the institution's focus towards humanitarian efforts by drawing on indigenous knowledge as a resource to enhance development processes.

Over the years, considerable progress has been made in promoting indigenous knowledge. In 2010, the World Bank's [2] published its Indigenous knowledge for development: a framework for action. The framework explains the need for indigenous knowledge to play strategic roles to expand the benefits of development assistance through the organization's development activities. Henceforth, the framework for action to increase understanding on the significance of IK amongst its development associates and to provide suggestions on how best it can be integrated into development practices. What is obvious is indigenous knowledge is considered essential for maintaining global cultural diversity and biological diversity.

The UN special rapporteur on indigenous issues has pointed out that indigenous communities around the world are the most effective custodians of millions of hectares of forest, which act as the world's lungs. It was suggested that localized indigenous perceptions of ecosystems and natural habitats are able to provide solutions to many of the world's problems from climate change to biological diversity.

Today, the role of indigenous knowledge are increasingly becoming part of the development agenda; national initiatives and policies have emerged, with civil society forming a broad base of support and the number of development projects as well as programs integrating traditional and indigenous knowledge has doubled up. This includes movement by indigenous peoples themselves to build a capacity building to maintain and protect biodiversity while at the same time creating alternative sources of economic income. A good example by the indigenous

communities themselves is the FORMADAT initiative. It was set up in 2015 as The Alliance of the Indigenous Peoples of the Highlands in the Heart of Borneo. According to Bala, et al. [3] the initiative is “to build on the shared historical and cultural bonds between the Lundayeh, Kelabit, Lun Bawang, and Sa’ban peoples living in the highlands of the heart of Borneo. The group aims to integrate conservation and development at the landscape level and to generate benefits for local people by preserving the rich natural and cultural diversity of the region, an area that includes the largest surviving intact forested and traditionally farmed catchment area on the island of Borneo.”

3. Defining indigenous knowledge

But what is indigenous knowledge? UNESCO provides a general portrayal to local and indigenous knowledge as the understandings, skills, and philosophies developed by societies with long histories of interaction with their natural surroundings. For rural and indigenous peoples, local knowledge informs decision-making about fundamental aspects of day-to-day life.

Others are more descriptive in their definitions of indigenous knowledge. For instance, Warren ([4], p. 127) argues, indigenous knowledge is a profound, detailed and shared beliefs and rules with regards to the physical resource, social norms, health, ecosystem, culture, livelihood of the people who interact with environment both in rural and urban settings. It has been the basis for local level decision making in agriculture, health care, food preparation, education, natural resource management, and a host of other activities.

Meanwhile, [5] highlights that “Indigenous people have had their own ways of looking at and relating to the world, the universe, and to each other. Their traditional education processes were carefully constructed around observing natural processes, adapting modes of survival, obtaining sustenance from the plant and animal world, and using natural materials to make their tools and implements” (as cited by [6], p. 10).

Gorjestani [7] observed that “Indigenous knowledge (IK) is used at the local level by communities as the basis for decisions pertaining to food security, human and animal health, education, natural resources management, and other vital activities. IK is a key element of the social capital of the poor and constitutes their main asset in their efforts to gain control of their own lives.”

Masango [8] defined indigenous knowledge as “The totality of all knowledge and practices established on past experiences and observations that are held and used by people”.

Gope et al. [9] characterized “Indigenous knowledge” as community-centric by nature, which reflects community practices and usually possesses a deep connection with land, locale, and community. Indigenous knowledge is highly tacit and hence it is quite difficult to codify and document Indigenous knowledge. Apart, indigenous knowledge is usually disseminating across generations through content and by virtue of observing the various community practices.

From the extensive definitions above, some common characteristics attribute to indigenous knowledge include the following:

- Multi-layered, multi-dimensional, based on a holistic worldview
- Connections between all living things
- Understanding for fair distribution of resource

- Integrated lifestyles (knowledge embedded in life)
- Modeled & exchanged implicitly
- Context-embedded artifacts

The characteristics listed above, highlights the knowledge gaps in current literature, calling for a deepening of understanding of what indigenous knowledge is, and how balance and fairness can be the basis for its assimilation. This paper explores these defining characteristics through the case studies explored, to shed some light towards a more balanced worldview.

4. Taking indigenous knowledge seriously

However, despite increased global recognition of indigenous communities' knowledge to maintain global cultural diversity and biological diversity, arguably indigenous knowledge is gradually disappearing. This is a result of worldwide rapid development and landscape changes and also as a result of increased encounters between the paradigms of indigenous knowledge and scientific knowledge.

There is little doubt that UNESCO [10] has highlighted a recent shift in the relationship between science and other systems of knowledge, reflected in the explicit recognition of indigenous knowledge in many global environmental governances described above. Nonetheless, there are still conflicting ideas about what it means to take indigenous knowledge seriously. There is still widespread assumption that science is superior to other knowledge systems. This stems mainly from the incommensurable between scientific and indigenous conceptual models, their ontologies, and their systems [11–14], which continue to create barriers to meaningful collaboration and the integration of indigenous and scientific knowledge.

As aptly described by Simeone ([15], pg. 1–2). He says, “Unlike the western custom of disseminating knowledge through publication, traditional knowledge systems exist principally in the form of songs, proverbs, stories, folklore, community laws, common or collective property and inventions, practices, and rituals. The knowledge is transmitted through specific cultural mechanisms such as those just listed, and often through designated community knowledge holders, such as elders. The knowledge is considered collective to the community, not private to one individual or small group.” He went to say that, “While Western science tends to be written and compartmentalize, IK are more holistic and are communicated orally. As orally based knowledge, IK are transmitted through observations and experiences while scientific knowledge are passed on through lectures and theories. Often times than not scientific knowledge are value-free and theoretical, whilst indigenous knowledge is more spiritual and embedded in social values.”

The differences can be demonstrated by the following two diagrams, which illustrate the framing of the two types of knowledge. Diagram 1(a) is an illustration of indigenous knowledge, which was co-created with remote community leaders. Diagram 1(b) on the other hand represents the prescriptive modeling of knowledge by researchers structuring and creation of scientific knowledge (**Figure 1**).

Due to the differences, some observers express concern that western science creates conflicts for indigenous knowledge and may even destroy it. This has led to calls for a shift in understanding indigenous knowledge to dismantle the barriers between indigenous traditional knowledge and scientific knowledge [16]. It is this call which inspires this chapter for it encapsulates the experiences we have gained

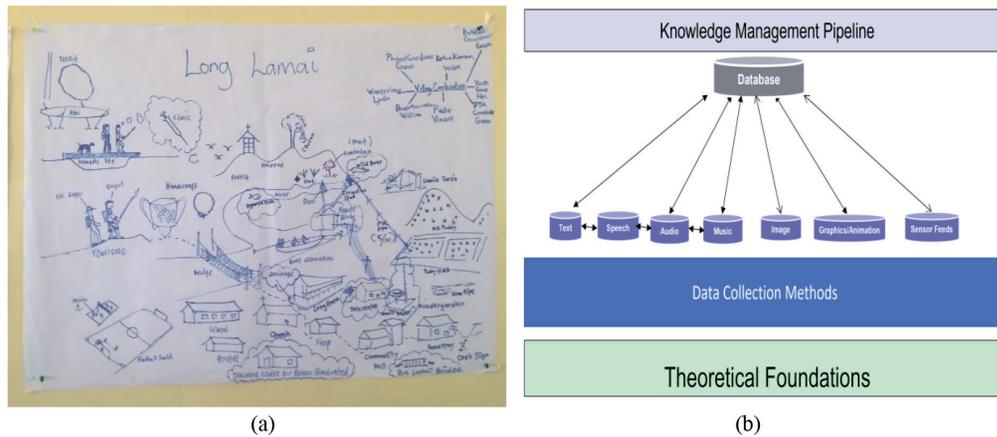


Figure 1.
 (a), (b): *The framing of indigenous and scientific knowledge.*

over two decades of research in rural digital inclusion efforts by introducing information communication technologies (ICTs), especially the internet as new tools for social and economic transformations amongst indigenous communities in Malaysia. This is within a challenging context: terrain with extreme variations in elevation, long distances, and sparse populations located in widespread locations. Moreover, with communities with diverse ethnic backgrounds and with different levels of socioeconomic status, and at times zero digital literacy.

The diverse and dispersed communities require a careful context-specific for the deployment of the information communication technologies and their designs. Not only the team encounter differences in terms of experiences and standard of living but lifestyle, cultural practices, and worldviews, which are constitutive of their indigenous knowledge.

5. Background context

In 1999 an interdisciplinary team of researchers based at Universiti Malaysia Sarawak (UNIMAS) has embarked on the e-Bario project in the Kelabit Highlands of Sarawak [17]. This was to explore how indigenous communities in remote and rural areas can be “integrated” in Malaysia’s race towards a Knowledge based-society by 2010. The knowledge society framework was deemed to inculcate the values and culture of life-long learning and the creation of knowledge-based products and services amongst its population. Exploring the use of telephones, computers, Very Small Aperture Terminals (VSATs), and the Internet, e-Bario was implemented as a pilot project to explore the economic, social, and cultural potentials of ICTs through community-based Telecentre model for rural development in Sarawak. This is especially because ICTs are predicted to promote new social, economic, and cultural opportunities in rural areas [18].

Due to its success e-Bario became a catalyst to explore the roles that telecentre can play in advancing community-based development amongst other indigenous communities in Sarawak, Sabah, and Peninsular Malaysia. As a consequence, the University has formed long-standing community-university partnerships with diverse and dispersed indigenous communities who live in remote and rural areas in Sarawak, Sabah, and Peninsular Malaysia.

The out-of-the-way locations of these indigenous communities create immense distance both in time and space and therefore exemplify the disconnected portion of the digital divide in Malaysia. They are often are without network access, lack of

adjacent infrastructure (e.g., grid electricity), lack of digital and language literacy, low income and affordability, lack of relevant content and services as well as lack of cultural and social relevance and therefore acceptance [19]. See **Table 1** for a complete list of the indigenous communities involved.

There is no doubt that because of the lack of digital and language literacy, it was easy to assume that these indigenous communities are knowledge-poor and incompetent in a global world. This is in spite of their capacities to manage the fragility of their own cultural heritage from human and non-human threats such as climate change. Their inherent indigenous wisdom are orally based and more embedded, therefore it was easy to overlook in the process of research and developmental efforts.

Moreover, digital innovation framework has been torn between a western-scientific idea and a more indigenous, community-based concept. Little attention is given to indigenous place-based knowledge, skills, and experiences within the

No	Communities (Ethnic Group)	Location	Geographical terrain	Economic activities	Language
1	Kelabit	Bario, Sarawak	Upland plateau	Wet Rice farming, hunting Process Timber Entrepreneurs	Kelabit
2.	Penan	Long Lamai, Sarawak	Mountain/riverine	Hill rice farming, hunting and gathering	Penan
3	Lun Bawang	Ba Kelalan	Highland/Valley	Wet rice farming, border trading	Lun Bawang
4	Bajau	Pulau Lারণ, Sabah	Island	Fishing	Bajau
5	Dusun	Kampung Buayan, Sabah	Mountain range	Farming, hunting, gathering	Dusun
6	Temiar	Pos Balar	Mountain/riverine	Farming, hunting, gathering	Temiar
7	Temiar	Pos Gob	Mountain/headwaters	Farming, hunting, gathering	Temiar
8	Semai	Pos Lenjang	Mountain/riverine	Farming, hunting, gathering	Semai
9	Semai	Pos Sinderut	Mountain/headwaters/valley	Farming, hunting, gathering, rubber tapping	Semai

Table 1.

List of diverse and dispersed indigenous communities and bridging digital divide initiative by the Universiti Malaysia Sarawak (UNIMAS).

expanding digital-based framework for knowledge management. These unique ways of knowing are important facets of the world's cultural diversity and provide a foundation for locally appropriate sustainable development. It is made up of a rich understanding of the plant, crop, and tree species, medicines, animal breeds, and local ecological and biological resources. This includes their useful and adaptive techniques to respond to changes in the physical and social environment.

Raise the question of whether it is possible to introduce and transfer academic knowledge about the new digital technologies without displacing the position or disintegrating the integrity of existing local indigenous knowledge.

6. Methodological framing

The method and approach employed have been largely guided by principles of participative, interdisciplinary, and transcultural interactions. First, it has been participative whereby indigenous local communities have been engaged in the design, planning, and implementation of the project. Second, the initiatives involved by an interdisciplinary team of researchers from different academic fields: anthropology, archaeology, geographer/geographic information system, computer science, and knowledge engineering sciences. Thirdly, it was transcultural in nature. It involved transcultural interactions between the scientists and community scholars, between members of the indigenous communities, and members of the multidisciplinary team. In short, it was a collaborative effort to ensure serious dialog and partnerships between knowledge experts and the local communities as collaborators. The latter are not merely recipients or objects of the technologies being introduced, but their worldviews and knowledge systems are taken seriously.

Raise questions in what ways can the team develop models, protocols, and frameworks, which not only support the unique structure of indigenous knowledge but also facilitate efforts to weave the two knowledge towards a better understanding of indigenous knowledge systems. Is it possible to formulate knowledge portals or protocols in order to assimilate two knowledge paradigms, for instance, to digitally integrate the knowledge of the past through a digital based framework to increase local awareness, interest, and understanding about the significance and value of their world to others who matter to them. Two case studies of socio-technical innovation below aim to answer these concerns.

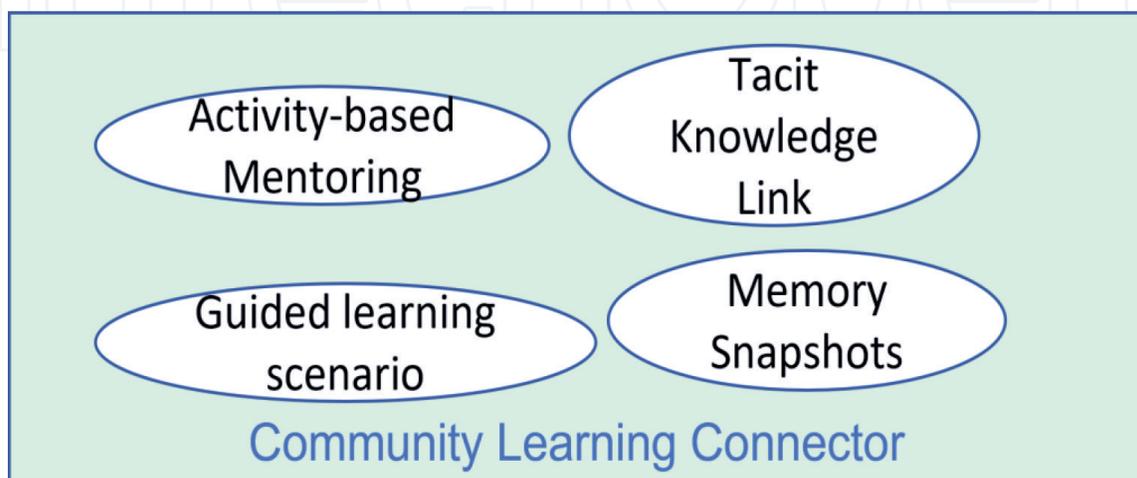


Figure 2.
Socio-technical innovation model.

6.1 Socio-technical systems innovation and case studies

Models of socio-technical technical innovation such as the telecentre as a driver for socio-economic impact need to be carefully co-envisioned and co-designed in a participatory manner. The context of the innovation has to adopt a knowledge-based inquiry and as a value-creation activity that benefits the people, the ecosystem, and the environment.

The design of such an Indigenous Innovation model has to be aligned to cultural protocols and norm and social practices to cultivate symbiotic relationships with people, the environment and nature (see [20]). This process-oriented model illustrated in **Figure 2**, will then drive balanced human-machine interactions and integrate with scientific exploratory models in solving complex problems [21].

7. Case study 1: community-led massive open online courses (MOOCs) for life long learning

The Massive Open Online Courses is an outcome of the emerging knowledge society to empower everyone to contribute to knowledge exchange at the global level; leading to making higher education accessible to everyone. (see for instance Anant, [22]). Nonetheless, MOOCs model and framework is a challenge to blend in with the indigenous rural community way of life to sustain lifelong learning. Single mothers Association community members in Bario made the ill-fitting very clear to us when we first mooted the idea at a focus group discussion meeting.

In response, the spokesperson said: “Thank you for introducing this new system to us. We look at it and admire how it works for instance to provide means to receive and learn new ideas and things. That is very admirable. However, I don’t think we need any more ideas from outside to make us better farmers. In fact, over the years we have developed our own farming system and we are very good at it. *Ilah let ngen tetepuh* [knowledge from our ancestors]. And this is evident from the sufficient rice and food we provide for our families and our community. We would like to ask, why not use the platform for us to teach our skills and our languages to others especially our grandchildren. Currently, most of us are far removed from our grandchildren since most of them are living in town and are going to national schools where they learn other languages such as Bahasa Malaysia and English. As a result, many do not know to speak their mother tongue. We are not really able to communicate and teach them at the moment because of the distance and language barrier. Can we redesign your platform for us to teach them our way of life - for instance how to prepare our own traditional food and to introduce our traditional adornment which are important as markers of identity.”

Another person went on to say, “With your platform [videos] you are able to capture what we do and keep them to show them. For we teach our younger generation by showing them how it is done. They learn from observing and trying it out for themselves. We don’t teach them by giving them instructions, because for us when they try and do it for themselves after seeing us doing it, that knowledge will last longer in their minds. I want to teach my grandchildren how to make this ornament using beads. There are many techniques that they should know, and they can only learn from us. Nobody else knows how to do this; they cannot learn it on their own. They have to learn from us.”

Invited as collaborators, the single mothers’ community members reshaped the current model of MOOC by fitting it into specific roles in the community. First, they have made it clear that they did not need any more information

to upgrade their standard of living as farmers. Second, they would like to ensure that the knowledge – skills, expertise that they have accumulated over the years, not only be documented but to be passed on to their descendants (grandchildren).

More importantly, by turning the project into a community-driven activity, the single mothers are transformed into knowledge creators and co-designers and not merely consumers of technological-based frameworks. They have redesigned the MOOC channel into community sustainability channels. Their stories suggest that for it to be fully appreciated, MOOCs has to deliver value as an integrated socio-technical system to enable life-long learning for indigenous rural communities.

8. eToro: innovation ecosystem

This research began in 2007 amongst the indigenous Penan community in Long Lamai, Sarawak. Nomadic in the recent past, they still depend on the forest for their livelihood. Through a trans-disciplinary, participatory approach, a long-standing partnership has evolved to closely mirror indigenous practices in knowledge sharing [23–25].

The socio-technical model approach as a knowledge-sharing networks started with the acknowledgment of the tremendous knowledge repository possessed by the community elders and which are implicitly locked in traditional practices. In order to understand their traditional knowledge system, the team adopted a visual charting approach to map the close link between the community laws, nature, the rainforest, social practices, language, culture and heritage, and customary practices and rituals.

The deep connection between the land, locale, and community began to unravel through a family-based activity known as the Toro journey. As an intimate joint activity of a Penan family, Toro is an activity-based knowledge sharing and mentoring journey, which is usually undertaken within a period of a week solely for hunting, to collect forest resources, and also to groom future guardians of the forest (**Figure 3**). This is where plant knowledge related to social beliefs and for daily use is shared and transmitted. This includes knowledge of medicinal plant use and the meanings of different landscapes in their environment. As a forest-journey interactions and knowledge exchanges, the Toro journey provided snapshots on models of multidimensional layers of inherent indigenous wisdom.



Figure 3.
Penan elder: If you do not know your origin [Forest], you are not a Penan.

There is a concern that with the intervention of modern technology through the telecentre, the knowledge related to this symbiotic relationship might erode. But, the blended socio-technical model approach has enabled the rural community's 'knowledge-rich scholars' to co-create technological solutions and involves the community to decide on the design of the system thereby allowing a naturalized participation and involvement in collaboratively recording indigenous knowledge. A botanical indigenous knowledge base was thereby developed via a coordinated co-creation method where the elders worked closely with rural youths in documenting local knowledge. The knowledge elicitation activities benefitted fully from the community's integral knowledge management capability without overlooking implicitly indigenous values.

What is clear is that compared to a purely systemic approach in modeling community sustainability, the approach has revealed directions for unlocking intangible benefits by truly harnessing the previously untapped cultural heritage and implicitly held knowledge resources. Moreover, through the approach a multi-level decision-making process involving the community players in a variety of roles such as knowledge extraction system and systems interface co-designers, a co-constructed socio-technical innovation in an ecosystem of the equal partnership was produced (**Figure 2**). The drive of the spirited community that believed in the utmost need to conserve a symbiotic relationship with nature and the forest has been the impetus in empowering a values-based socio-technical innovation.

9. Findings and discussion

The cases above suggest that any scientific knowledge and technological innovation as drivers either to promote knowledge-based products and services or to create values and culture of life-long learning amongst indigenous communities require careful co-envisioned and co-designed in a participatory manner. The context of the innovation has to adopt a knowledge-based inquiry and a value-creation activity that benefits the symbiosis between people, ecosystem, and environment. It is imperative to ensure that the intervention of modern technology must not erode knowledge processes related to this symbiotic relationship.

This is important to bear in mind as indigenous communities are under increasing pressure to adapt to global knowledge. In their encounter with scientific knowledge, the values of their indigenous cultural knowledge are often in a disadvantageous position and being undermined. This is in spite of the increased global recognition of indigenous communities' knowledge not only to help indigenous communities to be resilient, live sustainably in the face of challenges such as climate change, but also to maintain global cultural diversity and biological diversity.

For the interdisciplinary team from UNIMAS, who values sound methodological research, reframing the methodology towards participative, transcultural dialogs provide a framework to adopt a balanced indigenous worldview leading to protocols that inculcate the recognition of the coexistence of multiple worldviews and knowledge systems. Compare to a purely systemic approach in modeling community sustainability, the groundbreaking methodological model led to the development of a socio-technical technical systems innovation. As illustrated in **Figures 4** and **5** this can lead to the harnessing of indigenous knowledge and worldviews to design indigenous innovation models. It involved the repurposing of technologies by aligning them to cultural protocols and norms and social practices to cultivate symbiotic relationships with people, the environment, and nature. The process-oriented model (**Figure 2**) allows for a balanced human-machine interaction and the integration of scientific exploratory models in solving complex problems.

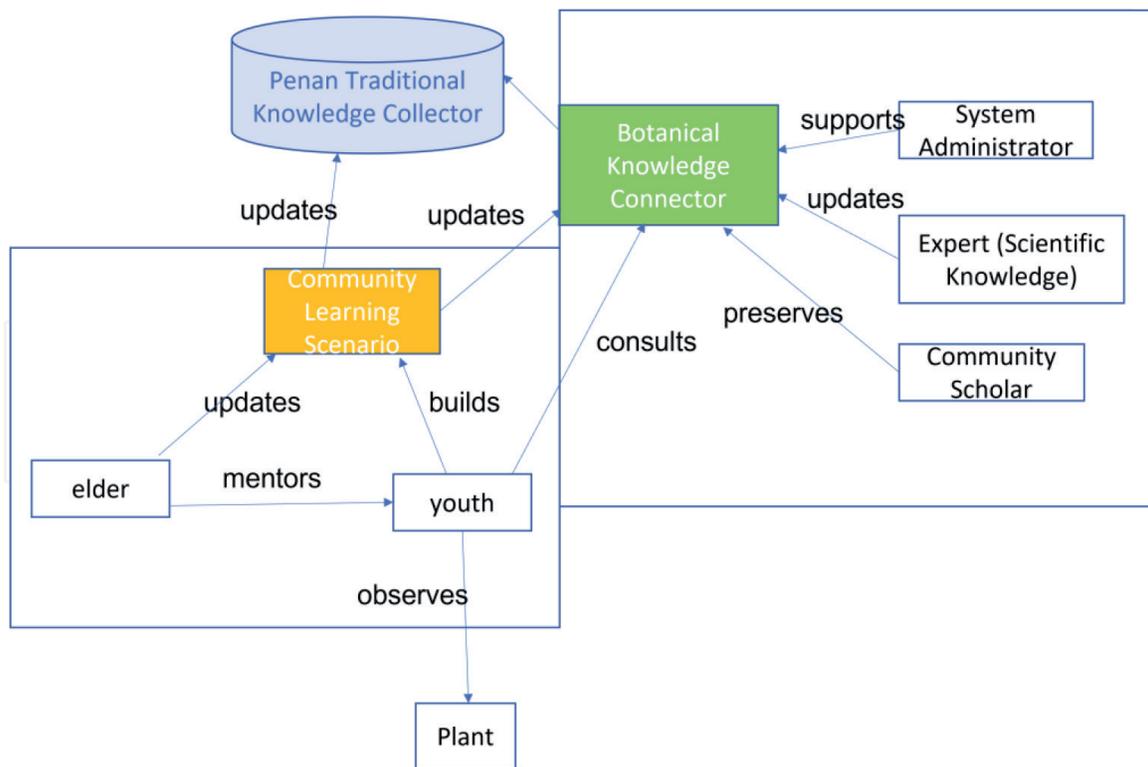


Figure 4.
eToro – Innovation ecosystem. Source: Adapted from [26, 27].



Figure 5.
MOOCs for community sustainability channels.

Harnessing their oral-based indigenous knowledge expressions, the indigenous single mothers of the Kelabit community participated in producing MOOC modules with the reshaped model. This is to enable life-long learning for the indigenous women and their grandchildren through their community sustainability channels (**Figure 5**).

Meanwhile, the e-Toro innovation system highlights indigenous place-based structured knowledge. Through the Toro journey as an activity-based knowledge sharing and mentoring journey, tacit indigenous knowledge is demonstrated and observed through carefully selected oral stories in which instruction and values are embedded. In **Figure 3**, the designated community knowledge holder, a Penan elder transmits the value of knowing the forest: If you do not know your origin [Forest], you are not a Penan.

As depicted in case studies, the inherent layers and dimensions of societal structure have to be preserved in the co-design efforts, to integrate within an encompassing framework that stakeholders can relate to and contribute to in a meaningful way. Connections between all living things relates to an over-arching principle of “unity in diversity” that has captured (as in both case studies) in the simplistic modeling terms through life-illustrations and analogical models of co-creation.

10. Conclusion

Clearly, indigenous knowledge is integral to a cultural complex that also encompasses language, systems of classification, resource use practices, social interactions, ritual, and spirituality. The recognition that local and indigenous people have their own ecological understandings, conservation practices, and resource management goals has important implications as indigenous people are now recognized as essential partners in environmental management.

The paper has revealed directions, protocols, and framework for collaborative engagement between two different paradigms with regards to intangible benefits of previously untapped cultural heritage and implicitly held knowledge resources amongst indigenous communities. It has shed insights into how the socio-technical innovation model, which is a balanced ecosystem where technology is embedded into a social system as an integral knowledge weaving, provides a useful system framework to contextualize indigenous knowledge within contemporary problem-solving scenarios.

As highlighted in this paper, the need to create a playground for the exchange of implicitly held knowledge, in co-created models that preserve the local context and scenario, and yet at the same time not separated from life-learning situations holds the key to the symbiotic blending of knowledge.

Author details

Poline Bala^{1*}, Narayanan Kulathuramaiyer² and Tan Chong Eng³

1 Institute of Borneo Studies, Universiti Malaysia Sarawak, Kuching, Malaysia

2 Institute of Social Informatics and Technological Innovation, Universiti Malaysia Sarawak, Kuching, Malaysia

3 Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak, Kuching, Malaysia

*Address all correspondence to: bpoline@unimas.my

IntechOpen

© 2022 The Author(s). Licensee IntechOpen. This chapter is distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. 

References

- [1] Adam L. Information and communication technologies, knowledge management and indigenous knowledge: Implications to livelihood of communities in Ethiopia. 2012. Available from: <http://unpan1.un.org/intradoc/groups/public/documents/un-dpadm/unpan040822.pdf> [Accessed 10 August 2021]
- [2] World Bank Group. Indigenous Knowledge for Development: A Framework for Action. Washington, D.C: World Bank Group; 2010. Available from: <http://documents.worldbank.org/curated/en/388381468741607213/Indigenous-knowledge-for-development-a-framework-for-action>
- [3] Bala P, Narayanan KR, Harris RW. From the margins to the mainstream: indigenised development in borneo with information and communication technologies and its contribution to global sustainable development. *Journal of Borneo Kalimantan*. 2020;**6**(2):19-35
- [4] Warren DM. The Role of Indigenous Knowledge in Facilitating the Agricultural Extension Process. Bad Boll, Germany: Paper presented at International Workshop on Agricultural Knowledge Systems and the Role of Extension; 1991 May 21-24
- [5] Ascher M. *Mathematics Elsewhere: An Exploration of Ideas across Cultures*. Princeton, NJ: Princeton University Press; 2002
- [6] Barnhardt R, Kawagley AO. Indigenous knowledge systems and alaska native ways of knowing. *Anthropology & Education Quarterly*. 2005;**36**(1):8-23. DOI: 10.1525/aeq.2005.36.1.008
- [7] Gorjestani N. Indigenous knowledge for development: Opportunities and Challenges. Geneva: United Nations Conference on Trade and Development; 2000
- [8] Masango CA. Indigenous knowledge protection: Prospects in South Africa's intellectual property framework. *South African Journal of Libraries and Information Science*. 2010;**76**(1): 74-80
- [9] Gope L, Behera SK, Roy R. Identification of Indigenous Knowledge Components for Sustainable Development among the Santhal Community. *American Journal of Educational Research*. 2017;**5**(8):887-893. DOI: 10.12691/education-5-8-8
- [10] UNESCO. Towards a UNESCO Recommendation on Open Science Online Consultation for Indigenous Peoples on the UNESCO Recommendation on Open Science 15 January 2021, United Nations Educational, Scientific and Cultural Organisation. 2021. Available from: https://en.unesco.org/sites/default/files/indigenous_people_report_unesco_recommendation_os.pdf [Accessed: 21 August 2021]
- [11] Atran S. The vanishing landscape of the Petén Maya Lowlands: People, plants, animals, places, words, and spirits. In: Maffi L, editor. *On Biocultural Diversity: Linking Language, Knowledge, and the Environment*. Washington, D.C., USA: Smithsonian Institution Press; 2001. pp. 157-174
- [12] Cruikshank J. *Do glaciers Listen? Local Knowledge, Colonial Encounters, and Social Imagination*. Vancouver, British Columbia, Canada: University of British Columbia Press; 2005
- [13] Pariyar A, Kulathuramaiyer N, Bala P. Towards participatory MOOCs. In: Crompton H, Traxler J, editors. *Critical Mobile Pedagogy: Cases of Inclusion, Development, and Empowerment*. New York, London: Routledge; 2020

- [14] Verran H. *Science and an African Logic*. Chicago, Illinois, USA: Chicago University Press; 2001
- [15] Simeone T. *Indigenous Traditional knowledge and Intellectual Property Rights*. Canada Government: Political and Social Affairs Division, Library of Parliament; 2004. Available from: <https://publications.gc.ca/collections/Collection-R/LoPBdP/PRB-e/PRB0338-e.pdf> [Accessed: September 1, 2021]
- [16] Agrawal A. Dismantling the divide between indigenous and scientific knowledge. *Development and Change*. 1995;26:413-439
- [17] Bala P, Songan P, Hamid KA, Harris RW, Khoo EGL. Bridging the digital divide: The eBario experience. *Sarawak Development Journal*. 2002;5(1):63-78
- [18] Ernberg J. Empowering communities in the information society: An international perspective. In: *The First Mile of Connectivity*. Rome, Italy: Food and Agriculture Organisation of the United Nations; 1998. Available from: <http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/Cddirect/Cdre0028.html> [Accessed: April 28, 2000]
- [19] Bala P, Tan CE. Digital inclusion of the Orang Asli of Peninsular Malaysia: Remote virtual mechanism for usability of telecentres amongst indigenous peoples. *EJISDC*. 2021;87(4). DOI: 10.1002/isd2.12171
- [20] Bala P. Social shaping of technologies for community development: Redeployment of information communication technologies among the Kelabit in Bario of the Kelabit highlands. In: Martin J, Hawkins L, editors. *Information communication technologies for human services education and delivery: Concepts and cases*. Hershey, NY: Information Science Reference; 2010. pp. 201-214
- [21] Kulathuramaiyer N, Pariyar A, Bala P, Meenatchisundaram JL, Kee-Man C. Preserving cultural knowledge through community-led MOOCs. *IPSI BgD Transactions on Internet Research (TIR)* 2020;16(1): 1-11. Web of Science Core Collection:Emerging Sources Citation Index
- [22] Agarwal A. Why massive open online courses (still) matter [Video file]. 2014. Available from: https://www.ted.com/talks/anant_agarwal_why_massively_open_online_courses_still_matter?language=en. [Accessed: September 30, 2019]
- [23] Zaman T, Kulathuramaiyer N, Yeo AW, Falak H. Modelling indigenous knowledge creation as a living system. *International Journal of Knowledge Management Studies*. 2015;6(2):136-150
- [24] Zaman T, Yeo AW, Kulathuramaiyer N. Harnessing mobile technology for penans indigenous botanical knowledge management. In: Hendriks DLEM, Grant S, editors. *Indigenous Lives in the Mobile Age*. Sydney: University of Technology; 2014
- [25] Zaman T, Yeo AW, Kulathuramaiyer N. Augmenting indigenous knowledge management with information and communication technology. *International Journal of Services Technology and Management*. 2013a;19:137-148
- [26] Zaman T, Yeo AW, Kulathuramaiyer N. Indigenous Knowledge Governance Framework: A holistic model for indigenous knowledge management. *ELOKA Workshop: Data Management and Local Knowledge: Building a Network to Support Community-Based Research and Monitoring*. Colorado, U.S.A.: University of Colorado Boulder; 2011a
- [27] Zaman T, Yeo AW, Kulathuramaiyer N. In: Bidwell NJ,

Winschiers-Theophilus H, editors.
Harnessing Community's Creative
Expression and Indigenous Wisdom to
Create Value. Tacit-Implicit-Explicit
(TIE) Knowledge Creation Model.
Proceedings of IKTC2011: Embracing
Indigenous Knowledge Systems in a
New Technology Design Paradigm.
Windhoek, Namibia; 2011

IntechOpen

IntechOpen