



Preserving Indigenous Weaving Techniques and Motifs through Digital Archiving and Sustainable Modern Adaptation

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ABSTRACT

The study focuses on the adaptation of traditional weaving skills and patterns by using digital means and modern materials. Weaving skills and products are a significant cultural heritage that involve physical material, skill, meaning, symbolism, oral transmission and a sense of community identity and intergenerational transmission. But, this continuity can be threatened if there are fewer opportunities for documentation and transmission of the specialized knowledge, and if it is dependent upon skilled individuals. The study takes a qualitative and exploratory design that examines the role of digital archiving in documenting weaving techniques and motifs, how digital technologies can support the documentation and intergenerational transmission of Indigenous weaving knowledge and practices, and how digital archiving and sustainable modern adaptation can help to long-term preserve and keep Indigenous weaving knowledge and practices relevant. The findings suggest that digital tools such as digital databases, visual documentation, video recordings, interactive systems, and other innovative tools can be used to enhance the preservation of both technical and visual elements of weaving, when integrated with the information about the meanings involved and the community's context. The study also reveals that digital resources have the potential to enhance access and learning for younger people, but not at the expense of the direct teaching of knowledge from artisans and community elders. Sustainable modern adaptation can also help to ensure the continuity of culture by providing opportunities for traditional weaving skills and motifs to be relevant to modern design and the economic situation, while respecting cultural authenticity, participation, ethical collaboration and the rights of Indigenous knowledge holders. The study suggests that a community-based, integrated, and holistic approach to the long-term preservation of Indigenous weaving should draw on the elements of digital documentation, intergenerational learning, cultural sensitivity, and sustainable innovation in order to ensure the weaving traditions are lived and meaningful cultural practices that can be enjoyed by future generations.

1. Introduction

Background of the study

Weaving of indigenous origin is an important aspect of cultural heritage, as it helps to maintain and pass on knowledge, identity, history, beliefs, art forms and environmental relations from one generation to the next, among communities. Traditional weaving is not just the making of a cloth for clothing or decoration but is rich in knowledge regarding the choice and preparation

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of fibres, spinning, dyeing, the structure and use of the loom, pattern making and the making of culturally appropriate motifs. Many of these skills are passed on from older to younger Indigenous artisans through observation, verbal instruction, hands-on experience, and direct teaching. Therefore, for every finished textile there is much more to the cultural system, including skills and embodied memory, stories, symbols, and relationships. Preserving traditional motifs is important for cultural continuity, as they can convey information about ancestors, nature, spirituality, social status, community identity or historical experiences. However, globalization, industrial textile manufacturing, modern ways of life, migration, lack of interest among younger generations, and the elimination of master weavers are impacting Indigenous weaving practices. If traditional knowledge is passed down mainly through the knowledge of elderly practitioners, and there are not many opportunities to hand down knowledge to younger generations, then some of the unique knowledge of weaving techniques and meanings that go with specific motifs can be lost. Choomanee et al. (2026) highlighted the need for such a wider perspective of textile heritage in their research on Karen weaving in Northern Thailand, revealing a link between weaving knowledge and community practice, inter-generational transmission, identity, ecological knowledge, and beliefs. In their research, they found that the preservation of the textile heritage needs to be addressed not only by preserving the material but also the immaterial elements such as the memory, documentation, photographs, digital media, artifacts and the involvement of the community. Therefore, the preservation of Indigenous weaving must take a holistic approach that not only records the look of the textiles but also the processes, knowledge, and cultural meanings, as well as the social relationships that underpin weaving traditions and ensure they remain alive and evolving within communities.

The archiving of traditional weaving techniques using digital technologies.

With the advent of digital technology, there are plenty of opportunities to keep the traditional weaving knowledge alive and to supplement the traditional approach to cultural conservation. Whilst museums, archives and photographs, written records and physical collections are important for the preservation of textile heritage, they are unlikely to fully represent the practical and embodied knowledge of producing a woven textile. Knowledge is built through repeated physical practice – such as hand movement; thread sequencing; tool use; material choice; and pattern and technical variation recognition – by a skilled weaver. This information can be challenging to convey with a finished textile or with a photo of a finished textile. The challenge may be met with digital archiving, which can incorporate several types of documentation: high-resolution images, videos, audio recordings, digital pattern databases, descriptions of materials, tools and techniques, and interviews with artisans and documentation of cultural meanings. These resources can provide a more nuanced description of weave traditions, and may assist with education and knowledge transfer both geographically and inter-generationally. In his research on the traditional “Wu Leno” weaving technique in Suzhou, Yu (2023) showed how digital databases and virtual technologies can help to preserve and sustain traditional textile heritage. The study showcased the documentation of patterns, modelling of weaving equipment and the creation of interactive experiences that bridge the gap between traditional craftsmanship and modern learning and innovation through digital systems. This is especially relevant to the current research as it shows how the digitization process does not need to give heritage a static information content, but when well designed, it can help to continue the transmission, interpretation, communication and development of traditional knowledge. A comprehensive digital archive would then preserve information relating to the weaving processes, local terminology, the materials, natural dyes, motif structures and meanings, the artisan experiences and culturally appropriate rules of access to specific knowledge for Indigenous weaving communities. This would allow digital archiving to serve as a strategy more than just for the storage of images of heritage objects, but as a way to capture and sustain living cultural knowledge (Yu, 2023).

Preservation of Indigenous Motifs and Cultural Meaning in a Digital Environment

The digital preservation of Indigenous weave motifs is special, as the motifs may have meaning that goes beyond their visual form. With the advent of modern digital technologies, scanning, photographs, classification, reproduction, modification and dissemination of textile designs can be done at a much faster pace and with accuracy. These capabilities can help with preservation, but can also pose difficulties if culturally significant motifs are removed from their communities and moved around without adequate knowledge and understanding of their significance, or without proper community participation. What might look to an outsider like an ornamental geometric or natural form, can actually be an entire system of cultural information to those who made it up. Motifs can include elements of ancestors, spiritual reflections, local topography, animals, plants, historical events or community identities. Good digital preservation would therefore not only include the preservation of the visual structure of a pattern. It should also reflect the meaning of the motif in its cultural context, the authority over the interpretation of the motif, whether or not it will be publicized, and how communities will retain control over the future use of their cultural knowledge. In their analysis of Ainu textile patterns, Medina-Gómez et al. (2026) called for a method that extends beyond simply analyzing the technical aspects of the patterns and considers the broader cultural and social aspects of Indigenous design knowledge. They highlighted the need for the interprofessional teaming of technology specialists, researchers, and Indigenous knowledge holders and expressed concerns about the centralisation of cultural datasets and the

results of research away from the communities in which these resources are located. This point of view is particularly pertinent to digital archives of Indigenous weaving as it implies the motif is not just another data element that can be extracted from or used for commercial purposes without considering its cultural context. Rather, digital preservation needs to be built with the community and needs to acknowledge cultural sensitivity, communal knowledge, contextual interpretation, and how access should be provided. Such an approach can contribute to the protection and communication of Indigenous motifs, and limit the potential for cultural decontextualization, misrepresentation or inappropriate appropriation in the digitization process.

Creating Sustainable Use of Indigenous Weaving Practices

Keeping or protecting Indigenous weaving traditions does not mean there should be no change, or that traditional textiles can be confined to museums and historical collections. When communities and artisans can continue to transmit their heritage into the present day and into the future and continue to have a connection to traditional practices and values, the cultural heritage can live on. Indigenous weaving techniques and motifs can be used carefully and appropriately in modern day-to-day garments, fashion accessories, interior products, textile repairs, digital design and other creative ways to make them sustainable. Adaptation, however, must be carried out in a responsible manner as the commercial market and mass production can sometimes create a product that is only superficially a decorative object that is not linked to its community of origin. A sustainable way of doing this needs to be a combination of innovation and cultural integrity, environmental responsibility, community involvement and sustainable economic opportunities for artisans. The traditional craft skills can also add to the current sustainability effort by promoting concepts like long life cycle manufacturing, local knowledge of materials, repair, waste minimisation and appreciation of the work and skill of handmade textiles. K. S. Et al., (2025) examined the possibility of using pre-consumer textile waste in Toda embroidery and how indigenous textile knowledge could be linked with sustainable fashion. They carried out research on traditional embroidery technique that was found to be useful in the textile repair and value addition activities to prolong the life of the materials and to preserve the attention to cultural heritage of the artisans. The example shows that the Indigenous skills and crafts are not just a thing that needs to be safeguarded from the modern world, but can even be part of the solution to the current world's environmental and economic problems. Sustainable adaptation can thus offer opportunities to keep traditional skills alive through innovative market opportunities and new applications, especially if the insight and design of weavers and communities are included in the decisions about the transformation of their knowledge and design. All this is more meaningful when cultural authenticity and community benefit are added to innovation and commercial success. It is therefore important to highlight that sustainable modern adaptation can help to preserve cultural continuity by making it possible to continue weaving traditions, make them visible, economically viable, and relevant for younger generations without losing the cultural meanings and knowledge underpinning such traditions.

Digital Innovation and Weaving Knowledge of Knowledge Intergenerationality

The sustainability of Indigenous weaving is heavily reliant on the capacity of communities to pass on its knowledge to the next generation, and digital innovations could be another means to help facilitate this. Weaving knowledge has, traditionally, been acquired by doing, observing, practicing, and through personal relationships with experienced weavers. Weaving methods continue to be vital, as the tacit and embodied knowledge of weaving cannot always be conveyed in written form. However, the use of digital technologies can augment traditional learning by allowing the documentation of demonstrations of complex techniques, the keeping of interviews and oral histories, the arrangement of information on motifs and materials, and the provision of educational resources that can be made available over time. New technologies that capture knowledge such as video, digital archives, interactive systems, virtual technologies, and others can assist in documenting knowledge that might be lost as artisans age and opportunities for firsthand, intergenerational transmission diminish. Charoenpanich et al. (2026) discussed the possible threats to the continuity of traditional textile practices in the Thai textile heritage industry by examining the problem of tacit knowledge capture by using artificial intelligence. The artisans' study also revealed that their concerns were with cultural erasure and that, on the whole, they were more likely to be interested in technologies that could support and enhance traditional crafts than take the place of the human practitioners. Furthermore, the research indicated that the perceived usefulness of technologies for capturing tacit knowledge was related to positive expectations concerning cultural and economic sustainability. The finding is significant in the context of the present study as it highlights the need to consider technology as a means of supporting the activities of artisans and communities and not as an alternative to traditional knowledge holders.

The Creation of a Digital Environment for the Preservation of Indigenous Motifs and Cultural Meaning

The digital preservation of Indigenous weave motifs is special, as the motifs may have meaning that goes beyond their visual form. With the advent of modern digital technologies, scanning, photographs, classification, reproduction, modification and dissemination of textile designs can be done at a much faster pace and with accuracy. While these may aid in preservation, they can also present challenges if culturally important aspects of culture are taken away from their communities and transferred

without knowledge and understanding of their meanings, or without the community's consent or participation. What might look to an outsider like an ornamental geometric or natural form, can actually be an entire system of cultural information to those who made it up. Motifs may feature aspects of family, spiritual thoughts, topography, animals, plants, historical or community identities. Good preservation of a digital pattern would thus involve not only the preservation of the visual structure of a pattern, but also other aspects. It should also embody the significance of the motif within the cultural context, authority over the interpretation of the motif, whether it will be published or not, and how the communities will have control over future use of their cultural knowledge. Medina-Gómez et al. (2026) argued for a approach to the analysis of Ainu textile patterns that goes beyond merely examining the technical aspects of the patterns, and takes into account the cultural and social aspects of Indigenous design knowledge. They pointed out how technologists, researchers, and Indigenous knowledge holders must work together as an interprofessional team and how there are significant concerns about the centralisation of cultural datasets and the outcomes of research from the communities that hold those resources and assets. This point of view is particularly pertinent to digital archives of Indigenous weaving as it implies the motif is not just another data element that can be extracted from or used for commercial purposes without considering its cultural context. Instead, digital preservation has to be developed within the community and has to take into account cultural sensitivity, the knowledge shared with the community, what it means in the context, and who has access to it. This could help to safeguard and share Indigenous motifs, while also minimizing potential for decontextualization, misrepresentation or inappropriate appropriation in the digitization process.

Woven from Sustainable Practice

Preserving and safeguarding Indigenous weaving skills does not require that there be no change, nor does it mean that Indigenous weaving traditions must be in museum and historical collections. When communities and artisans can continue to transmit their heritage into the present day and into the future and continue to have a connection to traditional practices and values, the cultural heritage can live on. Carefully and appropriately, indigenous weaving techniques and motifs can be incorporated in contemporary clothing for everyday use, in fashion accessories, in interior items, in the repair of textiles and in the digital design, and other creative methods of making them sustainable. However, adaptation should be done responsibly because sometimes the commercial market and mass production will result in a product which is just an external decorative object, without being connected to its community of origin. A sustainable way of doing this needs to be a combination of innovation and cultural integrity, environmental responsibility, community involvement and sustainable economic opportunities for artisans. The current sustainability drive could also be augmented by the traditional craft skills which encourage ideas such as long life cycle manufacturing, local knowledge of materials, repairs, waste minimisation and the appreciation of work and skill of handmade textiles. K. S. Et al., (2025) examined the possibility of using pre-consumer textile waste in Toda embroidery and how indigenous textile knowledge could be linked with sustainable fashion. They conducted research on traditional embroidery technique that proved beneficial in the textile repair and value addition program to extend the lifespan of the textiles and to keep the artisans' interest in cultural heritage alive. The example demonstrates that the Indigenous skills and crafts are not merely something to be protected from "modern" society, but can contribute to the solutions to the problems of today's world. Sustainable adaptation can thus offer opportunities to keep traditional skills alive through innovative market opportunities and new applications, especially if the insight and design of weavers and communities are included in the decisions about the transformation of their knowledge and design. When combined with innovation and commercial success, cultural authenticity and community benefit make a huge difference. It is also crucial to emphasize that the sustainable modern adaptation will enable the continuity of cultural tradition, as it will make it possible to continue the weaving of tradition without losing its cultural meaning and knowledge, as it will be seen as relevant and viable for younger generations, while it becomes visible in the context of sustainable development.

Weaving knowledge of knowledge intergenerationality is achieved through Digital Innovation

The continued existence of Indigenous weaving is greatly dependent on the ability of communities to transmit the knowledge to the next generation and digital innovations may be another way of doing this. The traditional method of learning about weaving is through doing, observing, practicing and personal relationships with experienced weavers. Weaving methods continue to be vital, as the tacit and embodied knowledge of weaving cannot always be conveyed in written form. The use of digital technologies can complement traditional learning, however, by enabling the recording of demonstrations of complex techniques, the recording of interviews and oral histories, the arrangement of information on motifs and materials, and the provision of educational resources that can be released over time. New technology that records expertise including videotape, digital archives, interactive systems, virtual technologies, and others can help ensure that knowledge may be lost when artisans grow older and there are fewer opportunities for knowledge to be passed from one generation to the next. Charoenpanich et al. (2026) discussed the possible threats to the continuity of traditional textile practices in the Thai textile heritage industry by examining the problem of tacit knowledge capture by using artificial intelligence. The artisans' study also revealed that their concerns were with cultural erasure and that, on the whole, they were more likely to be interested in technologies.

Research Objectives

To explore how digital archiving can help to keep Indigenous weaving skills and traditional patterns alive.

- To understand the potential of digital technology to document and share Indigenous weaving skills and patterns with the next generation.
- To explore the potential of digital archiving and sustainable modern adaptation to help maintain the legacy and ongoing significance of Indigenous weaving practices and patterns.

Research Questions

1. How is the use of digital archiving helping to preserve Indigenous weaving methods and traditional designs?
2. How can digital technologies help in the documentation and intergenerational passing down of Indigenous weaving techniques and motifs?
3. In what ways could digital archiving and sustainable modern adaptation help ensure that Indigenous weaving techniques and motifs are preserved and continue to be relevant?

The importance of the research project

The significance of this study is that it helps to understand how digital archiving can help to preserve the techniques of Indigenous weavers and traditional motifs. The practice of traditional weaving of indigenous peoples is an object of cultural heritage that can be manifested in technical skills, artistic knowledge, cultural values, symbolic motifs or through oral transmission and is part of the identity of the community. The research shows that it is important to not only protect the final products but also the processes used and intangible knowledge generated in the production of textiles. The research is carried out digitally with documentation, databases, visual records, videos and interactive technology that are useful for the preservation of traditional weaving for artists, cultural institutions, researchers, teachers, and cultural heritage institutions. It also highlights the importance of documenting techniques and motifs which retain the cultural context of the tradition and which can be passed on to younger generations. Thus, the research can help in the development of more integrated preservation strategies, which bring together technological tools with expertise and involvement of Indigenous communities.

The study also has an interesting aspect in that it deals with the relationship between cultural preservation and sustainable modern adaptation. The outcomes of its research can be supportive for the traditional weavers and artisans, designers, policy makers and organizations that wish to continue the relevance of traditional weaving in contemporary times. This study demonstrates that the combination of digital archiving and responsible use of knowledge in the present is possible: digital technologies can contribute to the preservation and documentation of knowledge, whereas adaptive contemporary use can create new opportunities for the traditional knowledge and motifs to remain alive and economically viable. Above all, the study calls for the adoption of a cultural awareness, community respect and the recognition of the role of the artisan as a source of knowledge while adapting. The study is an interdisciplinary approach to digital preservation, intergenerational continuity, community engagement and sustainable innovation, with the intent to provide a more holistic perspective on the potential for preserving Indigenous weaving practices, while at the same time enabling their adaptation in a rapidly changing societal, technological and economic context.

The research problem is formulated as a question. The research problem is stated in the form of a question. While there is much to be learned about the technical and cultural and symbolic knowledge of indigenous weaving practices and motifs, much of this knowledge is still dependent upon the experience, memory and first-hand transmission of skilled artisans and holders of knowledge of communities. The findings of this study suggest that while digital technologies can provide documentation and preservation for the weaving processes and patterns, visual images and technical patterns alone may not be sufficient to preserve the cultural meanings, oral knowledge and contextual information of these weaving patterns. Likewise, although digital tools can help younger generations access and explore traditional weaving techniques, the practical and communal approaches to learning and teaching embodied skills and culture can not be wholly replaced by a digital approach. The analysis also reveals that contemporary adaptation has the potential to make Indigenous weaving relevant and sustainable, but that in order for adaptation to be successful, issues of cultural authenticity, community involvement and the use of traditional knowledge need to be carefully addressed. Thus, the main research question in this study is that of how digital archiving and sustainable modern adaptations can interact in a way that enables the preservation of Indigenous weaving techniques and motifs, while allowing their documentation, intergenerational transmission, cultural context, continued practice, and community-based development.

Delimitation of the Study

The scope of this study is to analyze the efforts in the preservation of the indigenous weaving techniques and traditional motifs through the use of digital archiving and sustainable modern adaptation. The study is specifically about the use of digital technologies for documenting knowledge and motifs of weaving, for supporting the transfer of traditional skills and cultural meaning across generations and for the ongoing relevance of indigenous weaving in contemporary, responsible and sustainable ways. The research does not aim at the technical development or programming of specific digital archive systems, models of artificial intelligence, virtual reality applications or other technologies. It does not, also, make comparisons to all the weaving traditions of the Indigenous people in different countries or communities, but only presents a cursory comparison. Rather, the study adopts an ethnographic perspective to Indigenous weaving as a cultural heritage, and explores shared challenges and solutions to its digital preservation, knowledge sharing, community engagement, and sustainable adaptation. Therefore, the results are confined to the research objectives selected and the information and views available pertinent to these objectives.

2. Literature Review

Overview

Digital documentation has become an identified strategy to preserve the knowledge of traditional and Indigenous weaving practices, especially when a lot of weaving practices were found to be tacit and hard to be preserved through traditional museum collections or written documents alone. Traditional weaving practices involve the knowledge of materials, loom preparation, hand movements, dyeing techniques, and the construction of patterns, along with their cultural significance, which are often learned by observation and repetition. Yu (2023) suggested that digital technologies could be applied to the sustainable preservation and innovative development of traditional weaving by establishing electronic archives and using virtual techniques to record weaving patterns and processes. Likewise, Choomanee et al. (2026) concluded that Karen weaving knowledge is sustained by memory, handwritten documents, photographs, digital media, and the physical objects, which means that digital preservation can support, not supplant, community-based modes of knowledge transfer. Moreover, Charoenpanich et al. (2026) studied the application of artificial intelligence to document the tacit knowledge of traditional Thai weavers and concluded that technology might help to retain knowledge at risk due to the ageing of the traditional craftsmanship community and inter-generational differences. These studies all conclude that the extent to which digital archiving can record complex weaving practice in more than one medium is very promising and can be used to keep knowledge for future use. Yet it is also important to remember that technology must be linked to the human and cultural contexts within which knowledge is developed.

Digital Technologies for Recording and Interpreting Traditional Motifs

The second field of literature is connected to documentation, analysis, archiving and new interpretations of traditional textile motifs with the help of digital tools. The importance of traditional motifs in relation to cultural identity is that they may visually represent the people's identity and may have historical, social, environmental or spiritual significance. Gondoputranto and Dibia (2022) carried out a study to determine the potential of using technology for preserving traditional motifs that exist in Indonesia, such as batik, and in Turkey, and discovered that the traditional values of local cultures can be maintained without losing them if the traditional motifs are recreated, restored, and preserved by technology. Likewise, Medina-Gómez et al. (2026) explored the digital application of the analysis of Ainu textile patterns and highlighted the need to go beyond the technical dimension of pattern analysis to also consider Indigenous and pluriversal perspectives. They pointed to the importance of adapting the data and digital strategies to the social and cultural complexity of Indigenous cultural heritage and its communal knowledge. The other technological solution was the research on the mobile augmented reality and convolutional neural networks, which could potentially connect the motifs of tribal fabrics with oral stories and untouchable meanings, thus providing younger generations with cultural engagement (Bridging tangible artifacts and its intangible expressions, 2025). In these studies, it is demonstrated that the digital technologies can be used to enhance the visibility, accessibility and interpretation of traditional motifs. The studies conducted by Gondoputranto & Dibia (2022), Medina-Gómez et al. (2026) and the 2025 research on tribal fabrics emphasized on preservation and reproduction, culturally sensitive interpretation and immersive and recognition-based technologies, respectively. Therefore, literature suggests that digital preservation of motifs must be not only about the creation of visual reproductions, but also about the cultural narratives, meanings and knowledge systems that surround the significance of motifs.

The intergenerational and community engagement in the aspect of Textile Heritage

Community involvement and transfer of knowledge in the context of textiles heritage. Past research also indicates that community engagement and knowledge transfer from one generation to the next is a key factor in sustaining Indigenous textile

traditions. Digital tools can facilitate documentation and accessibility, but the knowledge of the artisans, elders and members of the community is still very important, where weaving traditions are maintained through practical experience and social networks. Choomanee et al. (2026) indicated that knowledge in weaving among the Karen people was mostly embedded in their embodied learning and intergenerational involvement while local ownership and participatory decision-making were also important factors in maintaining the heritage management. In a similar study, Ramkumar and Dias (2023) explored the traditional textile practices of the Indigenous Nongtluh women in North-East India and how Indigenous artisans are able to maintain the textile traditions that are integral to their cultural identity and livelihood amidst pressures of commodification and changing social conditions. They believe that recognition of the artisans as active carriers of cultural knowledge and not simply producers of cultural artifacts is important. In addition, Prasadja and Singgalen (2025) employed digital ethnographic method to examine the role of women in maintaining traditional weaving in Indonesia and advocated the link between women empowerment, intergenerational transmission of knowledge, cultural heritage, and sustainable development. These studies all show that technical documentation is not sufficient for successful preservation. Choomanee et al. (2026) emphasized the importance of community-based heritage management, while Ramkumar and Dias (2023) highlighted the importance of the role played by the indigenous women in the continuity of the traditional textile art, and Prasadja and Singgalen (2025) addressed the significance of women's role and their knowledge transfer in the weaving communities. Literature suggests that a meaningful community-based, education and intergenerational digital archiving approach is supported by a process of development. This can help to maintain the weaving knowledge with the living as well as help younger generations to understand the technical and cultural aspects of what they are handed down.

The goal of Sustainable Adaptation and Contemporary Applications of Indigenous Textile Knowledge is to investigate the modern uses and practices of indigenous textile knowledge and its sustainability. Another major topic in the literature is the transmission of the indigenous and traditional textile knowledge to the present textile design and production in a sustainable manner. Now there is an understanding that cultural practices do not necessarily have to be preserved as they are. Instead, sustainable adaptation can be done through cautious processes and adaptations of traditional techniques and motifs that can be relevant and can help support modern sustainability goals. However, the study on using pre-consumer textile waste in Toda embroidery revealed that the use of pre-consumer textile waste with Toda's traditional craft is one of the ways to prolong the life of clothes, minimize waste, and give the artisans economic opportunities (Integrating Toda embroidery with pre-consumer textile waste, 2025). Similarly, Babu et al. (2025) discussed the use of digital technology in the handloom weaving industry to complement design process and production efficiency, market access and enhance the connection with craft, sustainability and heritage. In addition, Zhang and Ng (2026) suggested a digitized sustainable preservation approach for traditional garment-making techniques, proposing that systematic digital documentation can be used to preserve intangible heritage and help to promote sustainable fashion. The studies illustrate examples of adaptation in different, but complementary ways. Babu et al. (2025) highlighted the role of environmental sustainability and the incorporation of Indigenous skills into repair practices in the context of the Toda embroidery research, while Zhang and Ng (2026) explored the intersection of digital transformation and traditional handloom production, and digital preservation and sustainable fashion and craftsmanship. A viable path is indicated by the literature with traditional knowledge being economically and socially viable with the help of modern adaptation. But adaptation has to be handled with great care to avoid the appropriation of cultural significance and the commercialization of Indigenous motifs into decorative items. Innovation and the respect of artisans, cultural knowledge, ethical production and continuous engagement of communities in decisions about using heritage in the present are best suited to sustainable adaptation.

The Future of Indigenous Weaving: Human-Centered Digital Preservation

The latest literature increasingly backs an integrated and human-centred approach to the future of Indigenous weaving. Technological innovation has the potential to separate cultural objects from the people and communities that give them meaning, but digital archives, artificial intelligence, augmented reality and other technologies provide important opportunities for documenting and communicating heritage. In their study, Charoenpanich et al. (2026) found that Thai weavers were concerned about cultural erasure and generally preferred technologies that complement and enhance traditional craftsmanship. Their results indicate that the value of digital innovation is greatly influenced by the extent to which artisans see it as aiding their knowledge and livelihoods. Likewise, Medina-Gómez et al. (2026) highlighted the need for culturally sensitive data and knowledge representation and social complexity and communal property in the use of digital approaches for Indigenous textile patterns. Furthermore, Yu (2023) showed that digital databases and virtual technologies could open new opportunities for the sustainable preservation, transmission, communication and innovation of traditional weaving techniques. The three studies offer complementary views of the relationship between technology and cultural continuity. Charoenpanich et al. (2026) explored human-centred AI and tacit knowledge capture, Medina-Gómez et al. (2026) highlighted indigenous and pluriversal concerns in digital textile analysis, and Yu (2023) showcased the potential of digital and virtual systems for living preservation and innovation. The literature then suggests that digitization should not be the sole basis for the future of Indigenous weaving

preservation. Instead, the effective strategies should combine technological documentation, community authority, cultural sensitivity, artisan involvement, intergenerational learning and contemporary sustainable applications. This holistic approach can enable digital systems to capture technical information and visual motifs while ensuring that Indigenous peoples are engaged in the process of interpretation, representation, sharing and adaptation of their cultural knowledge. This perspective offers a solid basis for exploring digital archiving and sustainable adaptation of the modern as two means of long-term preservation of Indigenous weaving techniques and motifs.

In this session, learners will explore how interactive technologies can be used to engage young people in the weaving of heritage

In recent years, interactive technologies have been discussed in the literature as ways to enhance the accessibility and engagement of traditional weaving heritage, especially for the younger generations who may lack direct access to traditional weavers. Whereas traditional digital archives are mostly images and written information, interactive technologies can enable users to engage with patterns, motions, stories, and textile knowledge. Rizal and Din (2026) examined how to use interactive motion-tracking technology to preserve Traditional Malay Kelarai motifs, and discovered that bodily interaction could provide immersive experiences that would enhance engagement with culturally significant geometric weaving patterns. Their research shows that digital interaction can offer alternative approaches to the presentation of motifs inspired by flora, fauna, abstract forms and other culturally relevant elements and can help to make traditional heritage more relevant in contemporary digital contexts. Likewise, Yu (2023) showed how virtual reality and digital databases could be utilized for interactive experiences of traditional weaving, enabling digital technology to play a role in preservation, inheritance, cross-cultural communication and sustainable innovation. Additionally, studies in the field of AR in fashion have demonstrated that the use of interactive digital tools can help to make Indigenous patterns more accessible to younger generations and to bridge the gap between traditional and modern fashion experiences (Augmented reality in fashion, 2025). All of these studies suggest that interactive technologies can enhance the link between cultural preservation and current learning. Rizal and Din (2026) studied motion-based engagement, Yu (2023) looked into virtual technologies for weaving preservation, and the 2025 study on augmented reality involved interactive fashion experiences to promote Indigenous heritage. The literature thus indicates that digital preservation can be more effective if users are not just passive consumers of the preserved content, but are provided with opportunities to explore, interpret and interact with traditional knowledge. These methods can be especially useful for Indigenous weaving, as they can provide a way for younger generations to become interested in the motifs and techniques, while simultaneously connecting with the cultural stories that make weaving meaningful.

The use of Participatory Design and Community Co-Creation in Digital Weaving Preservation

Another theme that has been identified from the literature is the need for participatory design and community co-creation in the creation of digital systems for the preservation of textile heritage. The design of digital tools is increasingly being challenged by the researchers, who believe that it is not only the responsibility of external technology specialists to design digital tools, as traditional and Indigenous weaving knowledge is intertwined with community values, cultural meanings, and systems of ownership. The study by Boonyaputthipong and Gilsdorf (2026) explored the use of digital applications to co-create new patterns for the Ikat textile with the weaving communities in Thailand, showing how technology can be used to facilitate the creation of new patterns while preserving links with traditional weaving cultures. They play an important role because they make community members part of the creative and technological process instead of a passive source of cultural information. In a similar fashion, Leon (2025) investigated the potential of human-centered participatory design in the context of passing down Mayan weaving knowledge to the next generation in Guatemala, and suggested a digital tool based on ethnographic research and the social dynamics of Mayan weaving communities. In another study related to this, Prasadja and Singgalen (2025) discussed the role of women in maintaining traditional weaving techniques in Indonesia, and the connection between community empowerment, cultural preservation, inter-generational knowledge transfer and sustainable development. All these studies highlight the importance of understanding who makes and controls technology, and whose knowledge is being represented in it, in order to be successful in digital preservation. Boonyaputthipong & Gilsdorf (2026) stressed the need for co-design with weaving communities, Leon (2025) emphasized participatory and human-centred approaches to knowledge transfer, and Prasadja & Singgalen (2025) emphasized the role of community members, especially women, as active custodians of weaving traditions. Thus, the literature has shown that the creation of digital archives and applications can be done collaboratively, taking into account the role of artisans and Indigenous communities as knowledge holders and decision makers, ensuring that technological innovation is culturally grounded and meets community needs.

The preservation of textile patterns using Artificial Intelligence and Advanced Systems

Another emerging field of study related to the conservation and adaptation of traditional textile patterns is the use of artificial intelligence and sophisticated computational methods. Artificial Intelligence and complex computational systems are also an

emerging research area related to the preservation and adaptation of traditional textile patterns. These technologies can help to preserve complex motifs, which would be more difficult to organize, document, generate, and recognize, systematically. Charoenpanich et al. (2026) studied tacit knowledge and its preservation with the use of artificial intelligence for the preservation of traditional knowledge in the Thai textile heritage industry and concluded that artificial intelligence can be used to support the preservation of tacit knowledge by the elderly craftsmen provided that the design of the technological system does not seek to supplant the skills of the craftsmen. Their study highlights the potential of human-centred AI to serve as a companion to capture embodied and nonverbal knowledge. Deka et al. (2026) introduced the LoomGen dataset and generative modeling system for Assamese handloom motifs, which showed the possibility of preserving motifs based on both visual and structural details and also enable the artisans to explore culturally inspired designs. Furthermore, the proposed ontology-based framework for Phum Riang silk heritage demonstrated the ability of structured digital knowledge systems to capture, organize and preserve information on traditional textile production processes, especially when the artisans grow old and the community's engagement in the production process decreases (*Ontology-based digital preservation framework*, 2026). These studies show various advanced technology applications such as the AI technique for tacit knowledge capture, the traditional motif generative modeling technique using AI, and the knowledge organization technique based on ontology. Charoenpanich et al. (2026) discussed the need for human-centric AI, Deka et al. (2026) highlighted computational supports for culturally appropriate preservation of motifs and creativity, and the Phum Riang approach underscored systematic approaches to knowledge management. Combined, this literature indicates that advanced digital systems can offer greater potential for textile preservation, but that the utility of these systems relies on the quality and cultural relevance of the data that they utilize, as well as on the continued engagement of those artisans and communities to determine how they interpret and reproduce traditional knowledge through these systems.

Digital Archiving as a strategy towards Cultural Resilience and Sustainable Heritage

Digital archiving is also discussed in the literature as a wider approach to reinforce cultural resilience and continuity of traditional textile heritage in the sustainable way. High quality archives can not only capture visual documentation and technical knowledge but can also capture the cultural history, material knowledge and relationships of weaving practice. Gondoputranto and Dibia (2022) showed that with the application of technology, like the use of digital archives and algorithmic systems, the preservation, restoration, and reproduction of traditional textile motifs can be carried out without necessarily eradicating the values of local cultures attached to the motifs. Choomanee et al. (2026) also identified a complex network of memory, handwritten records, photographs, digital media, artifact, local leadership, and participatory decision making in the process of protecting the Karen textile heritage. They also found that modern design and digital platforms could play a role in building cultural resilience by establishing networks and boosting artisans' livelihoods. Furthermore, Yu (2023) suggested that the use of digital databases and virtual technologies may offer practical means to preserve, inherit, communicate, and to sustain the traditional weaving techniques and technologies. The above studies indicate that the concept of digital archiving cannot be seen as a mere process of converting physical cultural objects to digital format. The preservation and technological reinterpretation of motifs is illustrated by Gondoputranto and Dibia (2022), while the localised and community-based knowledge management is highlighted by Choomanee et al. (2026), and the potential of digital systems to connect preservation and innovation is presented by Yu (2023). Together, the results suggest that digital archives may be part of cultural resilience when they document a variety of aspects of heritage and are tied to the communities that carry on the traditions. Implementing a sustainable strategy for the preservation of Indigenous weaving requires a combination of technical documentation and cultural context, community involvement and room for respectful modern adaptation. This can help to ensure the traditional knowledge remains relevant to artisans, researchers, educators and the younger generations while also helping to keep the traditions alive, and not just preserved.

3. Research Methodology

Overview

This research uses qualitative research method to analyze the preservation of indigenous weaving technique and motifs in the era of digital archiving and sustainable adaptation in the modern era. The methodology aims to gain deeper insights into the knowledge, experience, perspective and practice of traditional weaving, specifically how digital technologies can be used to document, preserve, transmit and adapt the textile heritage of Indigenous peoples today. Weaving is both tangible and intangible, including textiles, tools, material, motifs, cultural meanings, traditional weaving skills, oral knowledge and community practices, therefore, a qualitative approach is deemed appropriate to explore these dimensions in the cultural and social context. The study aims to gain an insight into the attitudes of artisans and stakeholders towards the importance of digital archiving in the conservation of knowledge about weaving and the potential to sustain them in relevance by adapting them sustainably. The methodology thus focuses on the detailed interpretation, rather than on numerical measurements, so

that the researcher may develop an understanding of the participants' perspectives on cultural preservation, technological adoption, intergenerational transfer of knowledge, documentation of motifs, participation of the community and the use of the motif in sustainable ways in the present.

Qualitative Method

This research uses a qualitative approach since it aims to understand the meanings, experiences and perspectives that people have around the work of Indigenous weaving instead of using statistical data to measure the relationships. Qualitative research is useful in studying cultural practices as it helps to understand phenomena in their natural social and cultural contexts, and offers a chance for the participants to speak for themselves. The qualitative approach in the current study will enable insights into the knowledge of artisans about traditional weaving techniques, their interpretation of weaving motifs and their understanding of opportunities and challenges in the context of digital archiving and contemporary adaptation. This will also help in the study of tacit knowledge that could be less easily measured, such as skills, experience, memory of culture, and inter-generational learning processes. The qualitative approach will be used to shed light on the themes and patterns of the preservation and sustainability of Indigenous weaving practices by exploring detailed descriptions and interpretations. The results will thus contribute to the contextual understanding of the possibilities of digital technology and sustainable innovation in use that will respect the cultural heritage and its continued use.

Data Collection Method

The main data collection methods will be semi-structured interviews with people who have knowledge and experience of the weaving and textile heritage of Indigenous peoples. This may involve traditional weavers, artisans, community elders, cultural practitioners, textile designers, and heritage preservation and/or digital documentation practitioners. The interviews will employ semi-structured format as a flexible approach to research areas that are pre-determined and to explore other experiences and perspectives raised during the dialogue. The following questions will be asked in the interview: What are some common weaving techniques used? What do they mean? What are their significance? How is knowledge passed down? What are some of the issues that threaten to end its practice? What do they think about the digital archiving process? What do they believe about how the traditional designs can be adapted and made sustainable in today's world? When relevant, secondary information may also be gathered from academic publications, heritage documents, digital archives and other sources to provide additional context to the information. Interviews with participants and documentary information will allow the researcher to gain a wider view of the topic and continue to focus on the knowledge and perspectives of people involved with the preservation of Indigenous weaving traditions.

Research Design

The research design is exploratory qualitative, as the research is focussing on the investigation and development of detailed understanding of the emerging relationship between Indigenous weaving heritage, digital archiving and sustainable modern adaptation. Given that the researcher is exploring a complex topic that needs to be studied through the eyes and ears of relevant participants, an exploratory design would be suitable. The study will examine the contemporary processes of transmission and retention of traditional weaving knowledge as well as possible obstacles to its survival and the potential contribution of digital tools to the documentation of techniques and motifs. It will also explore the transformation of traditional weaving for modern use in a sustainable and culturally conscious way. Thematic analysis will be used to analyse the data from semi-structured interviews and relevant documents, where the ideas, experiences and patterns will be identified, organised and interpreted with respect to the relevance to the research objectives and questions. The design will enable the study to relate individual experiences to wider questions of cultural sustainability, technological innovation, community engagement, and cultural preservation, and will create a fuller picture of the potential contribution of digital archiving and contemporary adaptations in facilitating the future continuation of Indigenous weaving traditions.

Theoretical Framework

The study is based on the concept of Intangible Cultural Heritage (ICH) which offers a suitable theoretical perspective of the understanding of Indigenous weaving as a living body of knowledge, skills, practices and cultural expressions passed down from generation to generation. Weaving is seen not only as a product but also as part of this a traditional craftsmanship, social knowledge, symbolic meanings and community identity are also introduced. The framework is particularly relevant because it emphasises the importance of the protection and conservation of heritage through identification, documentation, preservation, protection, promotion, transmission and revitalisation and also puts communities and knowledge holders at the centre. For this study, the conceptual framework of Intangible Cultural Heritage will be used to explore how digital documentation of indigenous weaving practices and designs can help to preserve them and transmit them and to understand how sustainable

modern adaptations could help to keep these alive and relevant. It will also inform the analysis of the linkage between technological innovation and cultural authenticity, acknowledging the necessity to involve communities in the process of preservation rather than viewing cultural knowledge as an object, distinct from those who produce it. Therefore, the theoretical framework provides a foundation for understanding the interwoven nature of the processes of digital archiving and sustainable adaptation, and how these processes can contribute to sustaining the protection of Indigenous weaving, respect cultural meaning, community ownership, intergenerational transfer and the life of traditional knowledge.

4. Analysis and Discussion

Overview

This analysis section looks at the results for the first research goal is to explore the role of digital archiving in the preservation of Indigenous weaving practices and traditional motifs. The analysis focuses on the role of digital archives in the documentation, organization, storage, protection and transmission of weaving knowledge (that may be at risk of being lost). The conclusions were not only that the archiving of photo images of textiles is a form of digital archiving, but that in order to archive the weaving heritage well, a combination of aspects needs to be recorded: techniques, motifs, materials, production processes, oral narratives, cultural significance and community knowledge. The analysis is organised around four main areas: documentation of weaving techniques, digital preservation of traditional motifs, documentation of cultural context and intangible knowledge and community engagement in developing relevant archives. The discussion also examines the results of this work as compared to other studies and highlights points of commonality and key thoughts for the conservation of a culture's textiles. Some existing research has come up with practices of cultural continuity, digital systems for preserving the visible and invisible aspects of weaving practices. For example, Jarusawat (2026) highlighted the need for local knowledge management, local participation, current designs and digital platforms to preserve the knowledge of weaving karen while Kinjo (2021) demonstrated the value of documentation of information and images from traditional crafts people for the creation of digital archives for future generations. Overall, the analysis takes as its view that digital archiving is an active process of preservation that can aid access, learning, cultural continuity and the preservation of knowledge, when it is linked to people and communities who are actively generating and sustaining the tradition.

The documentation of weaving techniques in a systematic manner

The first discovery is that the digital archiving has an important contribution in helping to systemically document weaving techniques that might otherwise remain in the memory and experience of individual artisans. Weaving knowledge extends beyond the actual textile itself, encompassing the preparation of fibres, the application of tools and looms, the order of weaving movements, the handling of fibres and fabrics, and the practical abilities acquired over a long period. Hence, it is not enough to only rely on pictures to capture the entire technique. Collecting video recordings, interviews, measurements, process descriptions, and visual records can all help to produce a more comprehensive digital record. A direct example of this is the work done by Kinjo (2021) who performed "literature surveys, measurement survey and interviews with traditional craftsmen to produce digital archive of such data and images for future generations." This direct statement is of special importance, as it clearly illustrates the possibility of combining various types of documentation to retain the practical skills for future use. The results indicate that digital archiving is most helpful when capturing the process of making, instead of the final woven product itself. Jarusawat (2026) also investigated the process of identifying, structuring, recording, and sharing knowledge in a community and found that knowledge management plays an important role in heritage preservation. Therefore, digital archives have the potential to convert disparate, individually held knowledge into organized resources that facilitate learning, research and cultural continuity into the future.

Digital Preservation of Traditional Motifs and Visual Patterns.

The second one suggests that digital archiving offers a valuable solution for documenting, structuring and preserving traditional motifs before they are lost, changed or forgotten. The motifs used in indigenous textiles can be difficult to describe verbally, and can often have complex visual structures. The use of digital imaging, motifs extraction, classification systems and metadata will enable the motif to be recorded in a format that allows for identification, comparison, retrieval and future study. Jamil et al. (2012) have shown this potential by devising an image processing technique for digitizing traditional motifs of Songket. Their work identified elements from the original textile designs and applied techniques like contrast enhancement, noise reductive, binarisation and morphological operations to digitalise the designs. Likewise, Gondoputranto and Dibia (2022) found that technology was effective in the preservation of traditional batik motifs of Indonesia and Turkish textile motifs. They found that digital techniques could help artisans to recreate traditional motifs and could make designs that were once lost in a digital archive. So the analysis shows that the value of digital archiving lies not just with the administration of the visual. A well-

organised archive can provide a searchable source of motifs and their properties and enable future generations to recognise and examine patterns that are no longer commonplace. The results, however, also suggest that it is necessary to include information about the name, origin, meaning and cultural context of the motif, so the design does not lose its connection with knowledge to make it meaningful.

Preserving Cultural Context and Intangible Knowledge through Digital Archives

The third finding indicates that digital archiving is more effective when it includes the culture within which weaving techniques and motifs were used rather than merely archive the textiles as visual objects. Oral stories, symbolism, material knowledge, community connections and knowledge of materials are all part of the weaving knowledge that is often transferred from one person to another. A digital archive with photographs alone can capture the visual characteristics of a textile, but lack information relating to the meaning of the design and the knowledge of it in a community. This concern is also evident in the study by Medina-Gómez et al. (2026), in which they found that there was a gap between technical studies that focus on the formal characteristics of Ainu patterns and ethnographic studies that focus on contextual characteristics. The researchers suggested that it is important for digital experts to engage with ethnographic and Indigenous experts, in order to include more cultural considerations in the digital reading of textile patterns. Likewise, studies of the textiles of the south have revealed a repository where stories, symbolic significance, personal and communal recollections, motif information, weaving methods, context and media resources have been linked within a larger body of knowledge. This study highlighted that these materials have the potential to “maintain visual, oral, and procedural knowledge that cannot be conveyed solely with written words.” This direct observation is relevant to the present analysis, in as much as it highlights the need for different types of digital documentation for different types of cultural knowledge. Thus, the purpose of digital archiving is not only to preserve the appearance of a textile, but to continue the links which connect the object, its creator, its community, its story and its cultural value.

Community Participation and Culturally Appropriate Digital Preservation

The fourth finding is that digital archiving for the preservation of Indigenous weaving is reliant on significant community involvement and culturally appropriate access to documentation and use of knowledge. While digital technology can help maintain access to cultural resources and expand cultural resources, it can also decontextualize from the communities that developed them when archives are developed without community involvement. Based on this evidence, the information to be recorded, how it is described, who can access it, and whether there should be a restriction on how it circulates or can be re-used should be decided with the involvement of Indigenous artisans and knowledge holders. With regards to the management and sustainability of Karen weaving knowledge, Jarusawat (2026) reported that strong local ownership, local leadership and participatory decision-making helped in the management and sustainability of the knowledge. This learning suggests that a more fruitful digital preservation is likely to have a stronger sense of value when the communities are not merely objects of collections, but are also active agents in the process. Similarly, in the conceptual paper on Badui traditional weaving, emphasis is placed on the importance of digital archiving that is grounded in the values of the community, and incorporates participative methods, information design and digital cultural ecology. Digital archiving is more than a neutral act of documentation, it is a representation of cultural knowledge and requires ethical considerations. The analysis thus indicates that digital preservation is technically correct and culturally responsible. The archive should: safeguard weaving techniques and motifs and acknowledge local knowledge systems / cultural values / community authority. At this level, the significance of digital archiving is greatest when technology is used as a means for Indigenous communities to preserve and share their own cultural information, not only for use by other people.

Demonstrating the weaving processes in recording

One of the most important findings is that many of the weaving techniques are passed on from one generation to the next, by observing, repeating, joining in and interacting with skilled artisans. The amount of time and opportunity for younger people to learn from the older ones may be diminished, however, by changes in lifestyle, migration, formal education and employment opportunities. Using digital technologies to record a demonstration of the weaving processes and provide access to it in ways that can be revisited can help overcome this challenge. Video documentation is especially helpful as it can record hand movements, loom operations, thread arrangements and the sequence of the technical procedures better than written documentation. Digital databases and virtual technologies were shown to have the potential of preserving, inheriting, communicating and innovatively developing the traditional weaving knowledge by Yu (2023). This discovery implies a new extension of traditional learning to digital systems which does not fully remove the need for highly skilled artisans. Likewise, Jarusawat (2026) noted that it is crucial to employ various methods of knowledge preservation such as memory, material objects, written documents, photographs, and digital media. The analysis suggests that digital technologies offer the greatest potential for support in intergenerational transmission when they serve as an ongoing learning resource that can be utilized

by younger generations in addition to the community-based teaching. Thus, in a way, technology can help to record demonstrations and explanations that might not be remembered if the knowledge-holders were no longer able to share them, all the while realizing that cultural understanding and mastery would not be possible without human contact and practice.

Digital technologies (interactive and immersive)

The second important finding is that the interactive and immersive digital technology could boost the younger generation's engagement with traditional knowledge and motifs of weaving. While conventional archives can offer useful information, they can also be passive, leaving the user to just look at an image or read a description. By means of virtual reality, augmented reality, interactive applications, and digital simulation, these technologies can make learning more active, enabling users to visualize patterns, learn the structure of the weave, and interact with cultural materials. In particular, Yu (2023) provided a clear example of how virtual technologies can be applied to preserve and pass on the traditional "Wu Leno" weaving technique, demonstrating that digital spaces can bridge the gap between heritage knowledge and new ways of learning and communicating. Similarly, Rizal and Din (2026) discussed about interactive motion tracking technology in traditional Malay Kelarai motif conservation and how interactive motion tracking technology can be integrated in the digital display of traditional pattern. This is important because weaving is a hands on and experiential activity, and interactive technology might enable a greater engagement with the experiential than static digital imagery. The analysis indicates that the traditional motifs and techniques can be interpreted in a more understandable and appealing way for the younger audience who is already used to digital environments by using the immersive technologies. The results also reveal, however, that engagement is not synonymous with full knowledge transfer. While digital interaction can help to present weaving heritage to younger generations and spark an interest, aspects of the culture, values, and real-world skills are not something that can be captured digitally, and need to be taught by artisans and knowledge holders. So, interactive technology is more about awareness and participation, a consideration that should not lessen but enhance traditional methods of learning.

The importance of digital technologies. The significance of digital technologies

The third discovery relates to the use of digital technologies to maintain and convey cultural connotations of Indigenous symbols. Intergenerational transmission is not just about instructing the younger generation in the ability to replicate a visual pattern. It also demands to pass on the stories, the terms, symbolism, historic memories, and cultural values linked to specific designs. Digital archives can be used to facilitate this process by associating good quality images of motifs with sound recordings of elders, video interviews with artisans, written explanations, local-language terminology, and information on cultural context. This allows younger generation to experience the tangible and intangible aspects of the weaving tradition. Medina-Gómez et al. (2026) stated that digital methods for studying Indigenous textile patterns should not be based on just technical considerations, and should incorporate Indigenous knowledge and other cultural contexts. This is important because a type might be reduced to a mere geometric shape or decorative pattern, and thus lose much of its cultural value, when it is recorded digitally. As a result the conclusions from the literature offer a more extensive documentation approach of a motif in which its meaning is transported with its digital representation. Gondoputranto and Dibia (2022) also showed that technology can help to document, store, and recreate traditional motifs, suggesting that digital systems can help preserve visual knowledge and enable it to be interpreted in the future. These technologies, when used in conjunction with other contextual data provided by the community members, can teach younger generations more about the motif than just the look of it, but its origin, its meaning, and its significance. The analysis then proposes that by setting up the archives as knowledge environments instead of mere collections of images, by connecting motifs and technique with the voices and interpretations of the communities from which they have come, digital documentation can reinforce the intergenerational cultural transmission.

Successful use of digital technology

The fourth finding is that, for intergenerational transmission to be successful with the use of digital technology, the continued involvement of artisans and communities in the production and management of digital learning resources is crucial. The interpretation of technology cannot be used as a definitive indicator of what parts of knowledge are culturally significant, what parts of the motifs can be interpreted, or what information can be shared with broader audiences. The knowledge and authority of the communities that carry on the traditions is needed for these decisions to be made. In the study of AI application in the tacit knowledge capture process in the Thai textile heritage industry, Charoenpanich et al. (2026) reported that artisans worried about cultural erasure and were generally hesitant to use technologies that would supplant their traditional craftsmanship. This is significant for the present analysis as it shows that technology that is developed for practitioners, based on their needs and knowledge is more acceptable and, perhaps, more sustainable. Likewise, Prasadja and Singgalen (2025) emphasized the need for involvement of the community and women for preserving and transmitting traditional weaving technique and the people involved in day-to-day cultural activities are still playing a significant role in continuity of heritage. The analysis thus suggests that the process of intergenerational transmission should be mediated through a human-centred digital model where

technology is used to record and support knowledge but the artisans, elders and community members continue to be the interpreters and teachers of the knowledge. Digital archives, videos, interactive systems, and more can help keep information alive for younger generations, but they're only effective if communities see them as culturally relevant and valuable. In general, the results indicate that digital technologies can reinforce or complement documentation and transmission processes by maintaining demonstrations, fostering engagement, transmitting cultural meanings and facilitating access to knowledge, though this will only be a long-term success if technologies are used in conjunction with traditional documentation and transmission processes and community authority, and not as an alternative to living cultural practice.

Sustainable modern adaptation

Protection and sustained engagement with the present through adaptation in the form of digital archiving and sustainable modern adaptation help towards the long-term preservation and continued relevance of Indigenous weaving techniques and motifs, suggests that the protection of traditional knowledge is more sustainable when it remains actively engaged in the contemporary world. A key conclusion is that digital archiving can build a permanent or long-lasting record of weaving knowledge and modern adaptation can offer opportunities for the continuance of weaving knowledge, its practice, development and value. The preservation of traditional weaving as a historical object in a museum or a digital collection can be problematic because the technical skills for traditional weaving might become lost over time. Traditional use, however, can still be relevant for contemporary clothing, accessories, interior fabrics, education and sustainable design, if documented knowledge is also used. Yu (2023) showed that the digital conservation of the “Wu Leno” weaving technique can help document, preserve, communicate and innovate. This discovery is significant in so far as it suggests that preservation and innovation are not inherently mutually exclusive. Likewise, K. S. Et al. (2025) demonstrated the possibility of using the pre-consumer textile waste as a resource in creating traditional Toda embroidery as a sustainable method in the field of fashion, highlighting the potential of Indigenous textile knowledge in addressing contemporary environmental concerns. The analysis thus points to the possibility of preserving knowledge through digital archive and sustainable adaptation through new contexts in which the knowledge can continue to be used. These strategies, when used in combination, can help to provide continuity and continuity for Indigenous weaving, both for the cultural protection of weaving and for the social relevance. Adaptation, however, should be linked to the knowledge and values of the communities affected, to avoid the loss or distortion of cultural identity in the process of contemporary innovation.

Economic opportunities

Both findings show how sustainable modern adaptation can open up economic opportunities to sustain Indigenous weaving. Traditional craftsmanship is intrinsically linked to the viability of traditional artisans who are able to earn a living from their work. Unfortunately, when weaving is time-intensive and not economically profitable, the younger generations are less likely to learn the art and skilled weavers might have to cut back or stop and continue to weave. Traditional techniques and motifs can be adapted to their use in innovative products and markets, and digital platforms and archives can help raise awareness of artisans and their products. Choomanee et al. (2026) concluded that the sustainable future of Karen textile tradition could be supported by contemporary designs and digital platforms by increasing networks and helping the livelihoods of artisans. This indicates that the connection of the weave to new consumer tastes and preferences may rely at least in part on its continued impact on its root cultural identity. Similarly, Jalil and Alison (2026) stated that the contemporary design could be achieved by the reinterpretation of Indigenous cultural expressions through ethical collaboration, sustainable materials and meaningful involvement of Indigenous artisans. The analysis suggests that it is best for the economic adaptation to be sustainable if the artisans are not treated as commercial producers only but as custodians of cultural knowledge and stakeholders in design and decision-making. Digital archiving can reinforce this by recording the origins and cultural context of technique and motif, which can aid in the communication of authenticity and the identification of community products as genuine or not. Thus, a digital documentation and a responsible modern adaptation could contribute both for cultural conservation and for economic sustainability: conditions can be created in which traditional weaving can be practiced by people of the present and future.

The source of the innovation is culturally driven and based on a foundation

A third is that the creation of digital archives can lay the groundwork for culturally informed innovation, with documented weaving knowledge at the disposal of education, research, and (carefully managed) contemporary design. Designed and community members will be able to study traditional techniques, motifs, materials and processes without having to rely solely on imperfect memory or actual physical examples. This can help to sustain traditional knowledge while providing opportunities for new uses. The literature suggests, however, that the right to access digital information does not imply free permission for the reproduction and/or commercialization of all indigenous designs. Medina-Gómez et al. (2026) highlighted the need to take into account community knowledge, context, and the sociability of heritage data in digital research on Indigenous textile patterns. Their findings are significant for sustainable adaptation, in that, if digital availability were to lead to cultural

appropriation or the loss of motifs from their context, this would pose a risk to sustainable adaptation. In a similar technological project, Boonyaputthipong and Gilsdorf (2026) showed how digital tools could be used for co-design processes with weavers to create Ikat textile patterns. This is important, as it demonstrates the role that technology can play in enabling innovation through collaboration in order to avoid extracting cultural designs. The analysis thus points to the possibility of digital archives as platforms of responsible innovation if they provide the right kind of cultural information and engage communities in decisions about how to adapt. The best model is not a one-way street where designers take motifs from the archive to create new products, but one where archived knowledge is used to engage communication and interaction between the artisans, younger generations, and research and design. This partnership can foster innovation and keep cultures alive in their symbolic context and community control. It is thus possible that digital archiving can help bring the relevance of Indigenous weaving into the future by assisting in innovating from a heritage standpoint, but not from a purely external one.

The preservation of Indigenous weaving over the longer term

The fourth finding is that a balanced-technology, cultural authenticity, environmental sustainability, and community control are essential to the long-term preservation of Indigenous weaving. While digital technologies and modern design methods can offer significant opportunities, the results do not suggest that these technologies and methods should supplant the human knowledge and cultural relationships that are fundamental to traditional weaving. Generally, artisans in the textile heritage industry in Thailand favored a combination of technology and traditional skills to be used together, rather than a replacement of one technology for the other, and there was a concern about cultural erasure present (Charoenpanich et al., 2026). This gives one direction to the present analysis: technology is most useful in fostering communities' capacity to document, teach, manage, and develop their own heritage. Gondoputranto and Dibia (2022) also proved that the traditional motifs of the textile can be preserved and reproduced using technological methods, which means that innovation can be done together with traditional culture. The evidence combined indicates that it is not enough to digitize every technique or turn every motif into a commercial product in order to be relevant in the long-term. Rather, decisions must be made on what to document, what knowledge should be limited to a select few, how motifs can be adapted, and how the benefits of a contemporary use of motifs can be returned to artisans and communities. Environmental issues such as responsible materials, minimization of waste and durable production should also be taken into account for sustainable modern adaptation, respecting cultural meanings. The findings overall are that digital archiving and sustainable adaptation can contribute importantly and complementarily to the future of Indigenous weaving; digital archiving can secure knowledge and facilitate its transmission, and responsible adaptation can help to keep Indigenous knowledge alive in a changing social and economic landscape. The success of these initiatives relies, however, on the ability to include Indigenous artisans and communities in the middle of preservation and innovation, to make sure that these weaving traditions continue to be alive and dynamic cultural practices, not just digital records or design resources.

Discussion of the Study

This study yielded results to support the use of digital archiving as a tool that could be very beneficial for the preservation of Indigenous weaving techniques and traditional motifs. The analysis showed that not only is heritage weaving about the retention of finished products and textiles, but also important knowledge is contained within the knowledge of weaving; the hands; the materials; the tools; the orality; the symbolism; and the memory of the community. Incorporating digital technologies like high-resolution imaging, video documentation, digital databases, interactive applications, virtual technologies, and AI-supported systems, can support the documentation of these various aspects of knowledge in a manner that can potentially be passed on to future generations. The results also reinforce the notion that digital preservation has to coexist with other knowledge transmission mechanisms, such as the traditional ones. Whilst some of the demonstrations are being captured on film and some information is becoming more accessible with digital media, the cultural values and lived practices of Indigenous weaving are still very reliant on the skills of the weavers, elders and community knowledge holders. The study highlights the importance of collaboration of indigenous communities in decision making processes regarding documentation, interpretation, access and future use of their knowledge in community based digital archives. In this way, there is less risk of being able to preserve motifs only as visual data and without the context (culture) in which they are meaningful.

The study also demonstrates the potential for modern, sustainable adaptation for the relevance and sustainability of Indigenous weaving. Results indicate that preserving should not only be seen as safeguarding of traditions from change, but also that the traditional techniques and motifs should be able to live on in contemporary society if they are managed well, with innovation. There are opportunities for weaving to be seen and learned and to be economically viable in new applications, such as weaving into more modern design and sustainable fashion, as well as weaving education materials. Analysis also shows that yet the adaptation process should be done responsibly, without cultural appropriation, misrepresentation and commercialization without community benefit. Digital archives have a role to play in the responsible adaptation of techniques and motifs, enabling them to be recorded with reference to the place of origin, their meaning and the context in which they are used; communities should be consulted about the use and reinterpretation of the heritage they have. The findings overall suggest a multi-

generational strategy for knowledge preservation and transmission, involving sustainable innovation, a digital documentation process, and communities. This is a comprehensive solution where Indigenous weaving is not just a document in a book or a picture on a screen, but is a living cultural expression of Indigenous weaving.

5. Conclusion

The findings of this study have led us to conclude that the weaving technique and motifs of indigenous people are a valuable source of tangible and intangible cultural heritage which needs to be preserved in a long-term using effective method. Traditional weaving has technical knowledge, remembrance of culture, symbolism, artistry and community identity at risk because of changes in lifestyle, industrial production, skills in senior citizens and lack of intergenerational transfer of knowledge. Digital archiving can be a useful tool for documenting and preserving weaving processes, motifs, materials, tools, oral histories and cultural interpretations. Digital technologies can help organize and store information systematically and can support the protection of knowledge which would otherwise be limited to individual artisans' memory. But the study finds that it is not only a matter of having photographs or making databases for successful digital preservation, but also the cultural context of Indigenous textiles is of equal importance. Digital archives should then preserve the aesthetic attributes of the artifacts themselves, and the knowledge that underlies the artifacts—intangible knowledge.

It also identifies the benefits of digital technologies to enhance documentation and the transfer of Indigenous weaving knowledge, when used in this way. Video recordings, digital databases, interactive applications, virtual environments and other technologies can enhance the accessibility of traditional knowledge to younger generations and demonstrate and cultural information can be revisited. However, the results highlight that technology cannot take the place of the real-world skills of artisanal, elderly and community power holders. Many times, the skills of weaving are tacit, they are skills that one learns through practice, by watching someone else, taking part in the process, repetition and personal guidance. Therefore, the most effective way of intergenerational transmission is to combine traditional learning with the appropriate digital materials. This model emphasizes that technology should be used to facilitate access, documentation and engagement; and communities and knowledge holders are at the heart of the interpretation and transmission of their cultural heritage.

Finally, the paper proposes a sustainable modern method of the relevance of Indigenous weaving, by the adaptation and digital archiving. Responsible adaptation can provide possibilities to keep traditional techniques and motifs alive and alive, and digital archiving can help to stop the loss of knowledge. The fashion and textiles industry, education and design may also support sustainable uses such as supporting livelihoods of artisans and younger generations' involvement in their culture. But, sustainability is a balance of innovation and authenticity, which needs to be carefully balanced. No matter what is documented, shared and how traditional motifs are used in the present context, the voice of indigenous peoples needs to remain. So, the way forward for the preservation of Indigenous weaving needs to be a community-centred preservation that foregoes the exploitation of traditional knowledge and the idea that innovation is an attack on technology, and where technology is a means of strengthening traditional knowledge.

Suggestions

Recommendations for future preservation projects based on the results of this study include community based digital preservation archives containing photos, videos, oral history, and description of the significance of the motifs, local terminology, materials, and oral history. Archives should be documented accurately, culturally respectfully, and in a way that is appropriate, and should be developed and managed in partnership with indigenous artisans, elders, younger members of community, researchers, designers, and cultural organizations. Professional weavers should help pass on knowledge from generation to generation by using the digital resources and on-the-job training. Additionally, design concepts and products produced by designers/businesses with an interest in incorporating Indigenous motifs into contemporary products should be developed in an ethical way, involving design collaboration and community consent, and should be economically beneficial for the artisans. Technologies employed such as AI, VR/AR and interactive digital platforms can also be reviewed in relation to their applications in weaving education and conservation into future studies. Digital innovation and sustainable modern adaptation must be conceived and developed hand in hand and mutually supportive, both of them maintaining and promoting Indigenous cultural identity, and also supporting sustainable Indigenous traditions and ways of life into the future.

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