The Journal of Mind and Behavior
Winter 2025, Volume 46, Number 3
Pages 86–108
ISSN 0271–0137

Mind, Identity, and Material Culture: How Pottery Heritage Influences Collective Behaviour and Creative-Product Innovation in Ban Kruat

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The research investigates pottery heritage as a framework encompassing cognitive, social, and material dimensions, within the context of collective action and the generation of products and innovations in pottery art in Ban Kruat, Thailand, a community in Southeast Asia maintaining enduring ceramic practices. Drawing on perspectives from cultural psychology, material culture studies, and creative industry analysis, the study explores how embodied knowledge, inherited crafting techniques, and shared symbolic meanings in pottery production contribute to shaping individual identity and fostering communal creativity. Employing a mixed qualitative approach, including ethnographic observation, semi-structured

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interviews with potters, and artefact examination, the findings reveal that pottery heritage functions not merely as a preserved traditional craft but as a dynamic repository of social memory and a source of adaptive innovation. Data were collected from 100 registered community enterprise entrepreneurs, employing stratified sampling. A structured questionnaire with a 5-point rating scale (α=.921-.932) was utilised. Analysis included computation of means and confirmatory factor analysis (CFA). The study identified distinctive features of Ban Kruat pottery linked to its archaeological identity: 1) black-grey coloration, 2) durability, 3) coiling technique, 4) rounded bases, and 5) flared rims. To determine the clay composition, local clay was combined with pumice dust in a 2:1 weight ratio, yielding pottery with high strength (118.85 kg/cm^2) and low water absorption (2.78%) following firing. Three key factors significantly influenced community enterprise entrepreneur satisfaction: aesthetics (=0.971), identity (=0.912), and materials (=0.888). Model fit indices indicated strong fit: Chi-square=74.349, df=65, p=.200, Chi-square/df=1.144, GPI=.911, NFI=.939, CFI=.992, TLI=.988, RMSEA=.038. The results indicate that intergenerational transmission of skills, ritualised production practices, and material engagement with clay enhance collaborative conduct, reinforce social cohesion, and support product diversification aligned with current market demands. By interlinking cognition, identity, and material culture, this research contributes to the broader discourse on heritage-driven innovation, demonstrating how traditional craft systems can sustain cultural continuity while facilitating creative product development in a globalised economic context.

Keywords: Cultural Capital, Pottery, Archaeological Site, Creative Economy.

Introduction

The expansion of the cultural economy represents a fundamental driver for strengthening communities in the twenty-first century (Murzyn-Kupisz & Działek, 2013). It serves as a critical foundation for the creation of knowledge, collective wisdom, and identity, all of which shape local ways of living and may be leveraged as creative resources to generate sustainable economic value (Štreimikiene & Kačerauskas, 2020). The application of cultural capital in the development of community-based products constitutes a central mechanism within creative economy strategies across regions, highlighting the conversion of cultural significance into economic enhancement.

Pottery represents a technological and cultural achievement of early societies, reflecting accumulated knowledge associated with lifestyles, traditions, and ancient production techniques (Zhou et al., 2023). The origins of pottery knowledge at the Ban Kruat archaeological site in Buri Ram, Thailand, can be traced to the Neolithic period, when human societies transitioned from nomadic existence to settled agricultural communities that incorporated pottery production into daily life. This progression continued into the Bronze Age, marked by advancements in craftsmanship and kiln technology. Over time, the community produced high-quality ceramics characterised by intricate designs linked to

animistic belief systems (Pan et al., 2025). Historically, the Ban Kruat site experienced prolonged socio-economic and cultural development until approximately the fourteenth century, during which it was significantly influenced by Khmer civilisation through the expansion of Angkor Wat. Pottery from this period exhibited stylistic integration of local artistic traditions with Khmer elements, particularly in form and decorative motifs. Excavated artefacts commonly display brown and dark green hues, distinguishing this production centre. These ceramic goods were distributed to key historical cities, including Phimai, Sukhothai, Lop Buri, Suphan Buri, Ratchaburi, and Phetchaburi, where they were utilised in religious contexts associated with Khmer culture.

The Ban Kruat archaeological area was endowed with high-quality clay resources suitable for ceramic production and was strategically positioned along a trade route connecting Angkor Wat and Phimai. This location facilitated its emergence as a centre of expertise and technological knowledge in pottery production within the lower north-eastern region of Thailand. Subsequently, the area developed into a major hub for ceramic manufacturing, contributing to broader governmental, military, and economic advancement. The historical trajectory of pottery production in this region serves as evidence of the community's cultural evolution (Marwoto, 2019). In contemporary contexts, national policy in Thailand promotes the integration of cultural capital into community product development, aiming to generate income through the fusion of local knowledge, artistic expression, and cultural heritage, ultimately producing goods that embody community identity (Goli, 2025).

Contemporary production of Ban Kruat pottery draws upon traditional knowledge systems, adapting historical techniques and motifs to create new product forms. Designs are frequently derived from archaeological artefacts, serving as prototypes for innovation in form and decoration. The production process involves four principal stages: selection of raw clay, shaping, firing, and surface decoration, all of which depend heavily on manual craftsmanship within the community. Sustainable development in this context is supported through the integration of cultural, natural resource, and human capital, where local inhabitants and inherited knowledge collectively underpin long-term progress (Nonaka et al., 2024).

Pottery production in north-eastern Thailand dates back to the eighth century and reflects strong influence from the Khmer Empire, whose cultural and political expansion extended across a substantial portion of Southeast Asia (Piromgarn et al., 2023). Local knowledge systems function as cultural capital, reinforcing identity and communal pride. However, the Ban Kruat community in Buri Ram is currently experiencing pressures associated with modernisation, including migration and declining engagement with traditional practices. Consequently, ancestral pottery

knowledge is at risk of gradual disappearance. In response, initiatives supported by the Thai government aim to facilitate intergenerational knowledge transfer, strengthen local identity, and employ cultural resources as economic assets. These efforts are designed to preserve traditional expertise, sustain its continuity, and disseminate historical, social, and cultural knowledge across generations, ensuring the long-term safeguarding of regional pottery traditions (Intanee et al., 2023).

Accordingly, analysing pottery from the Ban Kruat archaeological site in relation to community product development constitutes a critical approach to utilising cultural capital through design-oriented methodologies. This includes experimentation with material compositions, such as incorporating volcanic rock dust with soil derived from pebble-based sources, to enhance product innovation. Such initiatives are implemented as contemporary community development strategies aimed at reinforcing both economic viability and social resilience. This study supports the community in recognising the importance of preserving traditional identity while simultaneously designing products that meet modern market demands, thereby contributing to the sustainable progression of the creative economy from local to global contexts.

Literature Review

This study adopts a participatory action research approach with the objective of developing an innovative pottery style for small community enterprises. The initiative employs clay as the principal raw material for the production of new ceramic products, while drawing upon community capabilities and existing cultural capital as the foundation for sustainable development (Figure 1). The research is guided by the following conceptual framework.

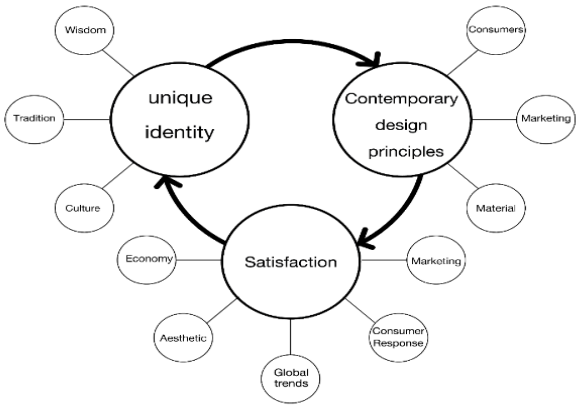

Figure 1. Conceptual Framework

The conceptual framework employed to examine the identity of Ban Kruat pottery is grounded in semiotic theory as articulated by Ferdinand de Saussure (Schumpe & Erb, 2015). This perspective emphasises that the interpretation of totemic identity should be situated within a shared temporal context, enabling a clearer understanding of meaning through the interrelationship between artistic expression and societal conditions. Accordingly, the research design is structured into four analytical components: 1) examination of forms and morphological characteristics; 2) identification of signs; 3) interpretation of sign meanings; and 4) evaluation for practical application. The reinterpretation of original signs into contemporary forms is informed by the notion of social myths, where semiotic transformation conveys meaning independently of textual representation. The evolution of symbols as a communicative medium is guided by three key principles: 1) symbolic interpretation, 2) explanation and inference derived from symbolic representation, and 3) refinement of symbols while preserving their original meanings (Del Vecchio et al., 2025; Stjepandić et al., 2025).

In the development of new pottery products, the study integrates the concept of innovation driven by cultural capital to generate added economic value, facilitated through active participation of community members. The implementation process follows four sequential stages: 1) planning, 2) execution and practical application, 3) systematic observation, and 4) reflective evaluation (Rasyid et al., 2024). This structured approach supports the preservation of traditional knowledge while enabling its adaptation within the context of rapid global transformation. Furthermore, it contributes to the evolution of cultural practices and community lifestyles through inclusive participation.

Methodology

Objectives

1. To examine the identity of ancient pottery within the Ban Kruat community, Buri Ram, Thailand.
2. To develop contemporary pottery products for small community enterprises.

Scope

The procedure for investigating the identity of ancient pottery in the Ban Kruat community, Buri Ram, Thailand, was implemented as follows. The target population comprised 40,870 residents of the Ban Kruat community in Buri Ram, Thailand. The study sample consisted of 100 residents from the Ban Kruat District Municipality, selected through stratified sampling at a 90% confidence level based on the Taro Yamane

table. A structured questionnaire focusing on the identity of the Ban Kruat archaeological site was employed as the research instrument. The questionnaire used a 5-point rating scale and demonstrated satisfactory reliability and validity (IOC = .856; Cronbach's Alpha = .931-.942), meeting established methodological standards (Peterson, 1994; Turner & Carlson, 2003). Data were analysed using mean values, SD (Standard Deviation), and EFA (Exploratory Factor Analysis).

The pottery design process for small community enterprises was carried out as detailed below. The population consisted of 122 members drawn from 11 registered community enterprise groups, all located within Ban Kruat District. The sample included 100 registered community enterprise entrepreneurs from the same district, determined at a 95% confidence level according to the Taro Yamane table. The instrument applied was a structured questionnaire assessing the suitability of the newly developed pottery style based on the identity of the Ban Kruat archaeological site. This questionnaire also utilised a 5-point rating scale and exhibited strong psychometric quality (IOC = .847; Cronbach's Alpha = .921-.932), satisfying the required criteria (Peterson, 1994; Turner & Carlson, 2003). Data analysis was conducted using mean values, SD, and EFA.

The development of the questionnaires and interview protocols received formal approval in compliance with Human Research Ethics Standards (EC-KMITL_66_108) from King Mongkut's Institute of Technology Ladkrabang.

Results

The investigation of the original pottery wisdom influenced by Khmer civilisation at the Ban Kruat archaeological site focused on four principal aspects: clay preparation, hand forming, decoration, and firing. The findings are presented as follows.

With respect to clay and its preparation, the analysis revealed that the majority of prehistoric pottery fragments excavated from Wat Pa Phra Sabai temple within the Ban Kruat archaeological site displayed black and grey coloration. Locally sourced Ban Kruat clay was identified as the sole primary material. During extraction from wetland areas, potters traditionally combined ball clay with grog to minimise cracking and improve workability during shaping. The distinctive black-grey appearance of the wares was attributed to the high iron content of the clay. In addition, the clay body exhibited a coarse and porous texture. Firing temperatures were estimated to range between 600–800 ºC, which contributed to the uneven surface characteristics observed in the finished products.

In terms of hand-forming techniques, the results indicated that pottery shapes were largely inspired by natural forms surrounding the community and were produced through simple manual methods (Figure 2). Specifically, potters used their fingers to press, compress, and shape the clay, primarily employing the slab-building technique. The pottery bases were predominantly rounded, with visible fingerprint impressions distributed across the surface. Furthermore, the coiling method was also utilised as an additional forming technique during production. Regarding decoration, the pottery was characterised by a black-grey, unglazed surface. Decorative elements did not include painted colour patterns; instead, ornamentation consisted mainly of cord-marked impressions and continuous grooved motifs created using sharp tools. The rims or edges were typically flared, extending beyond standard proportions. Supporting legs, where present, were formed as connected elements attached only to the base of the pottery. Concerning the firing process, the findings showed that once shaping was completed, the pottery underwent gradual air drying to reduce the risk of cracking. After thorough drying, the wares were fired in traditional clay kilns, using dry straw as the primary fuel source.

Figure 2: The Study on the Identity of Ancient Pottery at Ban Kruat Archaeological Site

The examination of the forms and decorative patterns of pottery from the Ban Kruat archaeological site indicated that all recovered wares belonged to the earthenware category (Figure 2). Artefacts identified within the kiln areas comprised: 1) ceramic projectiles used for hunting small animals, 2) clay collar bells for domesticated animals, 3) vessels with rounded bases and flared rims, 4) clay pots, and 5) coconut shell-shaped utensils. These items were produced using traditional techniques inherited from earlier periods.

The pottery assemblage was classified into two primary categories. The first category, Wares for Daily Life, included utilitarian items such as clay pots with both rounded and flat bases and flared rims, as well as plates, dishes, bowls, and storage vessels intended for routine use. The second category, Ceramic Wares for Special Occasions, comprised items associated with ceremonial or ritual practices, particularly those

connected to ancestral beliefs; such artefacts were comparatively rare within the findings. In the development of contemporary pottery designs, the study focused on determining appropriate mixing proportions and evaluating the physical characteristics of clay sourced from Ban Kruat District to ensure suitability for stoneware production. Ratio-based formulation principles were applied, whereby additional materials were incorporated incrementally in equal proportions, beginning with a baseline of 100 units of primary clay. The mixture aimed to enhance specific material properties through balanced composition. Two principal materials were utilised in this process: Ban Kruat clay as the base component and pumice dust added within a proportion range of 30–50%.

Based on the pre-firing test results (Table 1 and 2), the clay samples exhibited colour variations ranging from brown to dark brown-black.

Table 1

Mixing Ratios of Adding an Equal Ratio Each Time with a Total of 5 Digits

Formula	1	2	3	4	5
(1) Ban Kruat Clay (%)	100	100	100	100	100
(2) Pumice Dust (%)	30	35	40	45	50

All tested formulations satisfied the required standards for good plasticity; however, plasticity gradually decreased as the proportion of pumice dust increased, particularly within the 45–50% range. The resulting material texture was coarse and granular. Nevertheless, clay mixtures at all tested ratios remained suitable for shaping into test bars.

Table 2

Pre-Firing Test Results of 100 Proportions of Ban Kruat Clay Combined with Pumice Dust at a Ratio of 30–50%

Formula	Ratio (1)/(2)	Colour	Plasticity	Texture	Forming Test Bars
1	100/30	Dark Brown	Fair	Rough	Well Compressed
2	100/35	Dark Brown	Fair	Rough	Well Compressed
3	100/40	Dark Brown	Fair	Rough	Well Compressed
4	100/45	Black-Brown	Low	Rough	Well Compressed
5	100/50	Black-Brown	Low	Rough	Well Compressed

According to the firing test results (Table 3), clay samples across all mixing ratios successfully withstood firing at 1,200ºC without exhibiting melting. The fired clay displayed colour variations from tangerine and light brown to brown and dark brown, depending on the proportion of pumice dust incorporated into the Ban Kruat clay mixture (Figure 3). In addition, all formulations retained structural integrity after exposure to high-temperature firing. Notably, the clay composition in Formula 5 demonstrated the highest strength, reaching 118.85 kg/cm^2.

Table 3

Results of Physical Testing When Firing at 1,200 ºC

Test	Mix ratio (Addition)(1/2)	Shrinkage (%)		Fire Resistance (1200 ºC)	Fire Colour (1200 ºC)	Water Absorption (%)	Strength After Firi (kg/cm²)
		Before Firing	After Firing				
1	100/30	9.5	12.2	Passed	Dark Brown	6.20	66.48
2	100/35	10	13.75	Passed	Dark Brown	9.20	108.38
3	100/40	11	13.80	Passed	Dark Brown	6.71	99.83
4	100/45	9.80	12.8	Passed	Dark Brown	8.21	91.55
5	100/50	11	13.30	Passed	Dark Brown	2.78	118.85

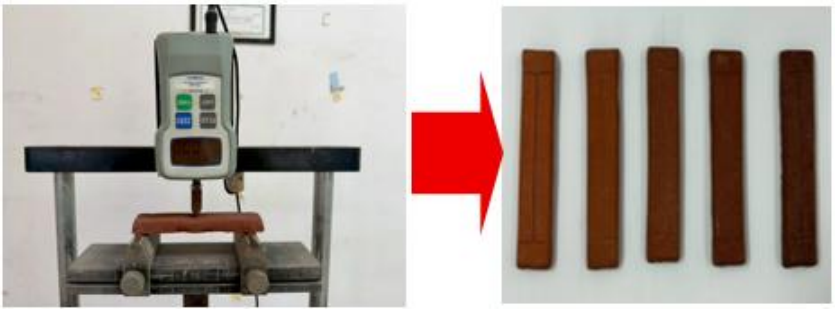

Figure 3. Five Formulations for Ban Kruat Clay Mixed with Pumice Dust Test Strip

Regarding the chemical characteristics of Ban Kruat clay combined with pumice dust, the compositional analysis was conducted using XRF (X-ray fluorescence) and XRD (X-ray diffraction) techniques, as presented in Table 4.

Table 4

Reports of XRF Test Results for Ban Kruat Clay

No.	Item	Results	Method/Instrument
1	Al_2O_3	13.830 (%) Mass	Standard Less Method/X-Ray Fluorescence Energy Dispersive Spectrometer Source: Laboratory at the Centre for Scientific and Technological Equipment, Suranaree University of Technology
2	SiO_2	79.626 (%) Mass	
3	SO_3	0.166 (%) Mass	
4	K_2O	0.185 (%) Mass	
5	TiO_2	0.951 (%) Mass	
6	Cr_2O_3	0.020 (%) Mass	
7	Fe_2O_3	5.356 (%) Mass	

*The results are reported based on 100% normalization of oxide compounds.

The XRF analysis (Table 5) indicated that Ban Kruat clay primarily consists of silica (SiO_2) at 79.63%, followed by alumina (Al_2O_3) at 13.83% and iron oxide (Fe_2O_3) at 5.36%. These findings suggest the presence of quartz (SiO_2) and kaolinite in the clay. In comparison, XRF analysis of pumice dust revealed it to be predominantly composed of silica (SiO_2) at 55.28% by weight, with alumina (Al_2O_3) at 14.73%, iron oxide (Fe_2O_3) at 12.50%, magnesium oxide (MgO) at 7.38%, and calcium oxide (CaO) at

5.39% by weight. These results indicate that the pumice dust contains quartz (SiO_2), calcite, and kaolinite, consistent with XRD analysis outcomes. The XRD comparison for Ban Kruat clay mixed with pumice dust at proportions of 30, 35, 40, 45, and 50% by weight, after firing to complete combustion, showed that all ratios produced amorphous silica. This occurred because part of the silica melted during firing and formed a glassy phase within the structure, subsequently crystallising into β-Cristobalite. Increasing the proportion of pumice dust enhanced the strength of the clay while reducing water absorption.

Table 5

Reports of the XRF Test Results for Pumice Dust

Item	Test Items	Test Results Sample Name: Behalt Stone Dust Appearance or Condition of the Sample: Clay Powder	Methods/Tools used for Testing
1	MgO	7.380 (%) Mass	Standard Less Method/X-Ray Fluorescence Energy Dispersive Spectrometer Source : Laboratory Science and Technology Equipment Center in Suranaree University of Technology
2	Al_2O_3	14.729 (%) Mass	
3	SiO_2	55.280 (%) Mass	
4	K_2O	1.572 (%) Mass	
5	CoO	5.390 (%) Mass	
6	TiO_2	2.835 (%) Mass	
7	MnO_2	0.172 (%) Mass	
8	Fe_2O_3	12.501 (%) Mass	
9	SrO	0.095 (%) Mass	
10	ZrO_2	0.044 (%) Mass	

*The results are reported based on 100% normalization of oxide compounds.

For pottery production within community enterprises, the design of pedestal tray-style items was informed by the community's cultural identity, drawing inspiration from ceramics uncovered at the Ban Kruat archaeological site (Figures 4 and 5).

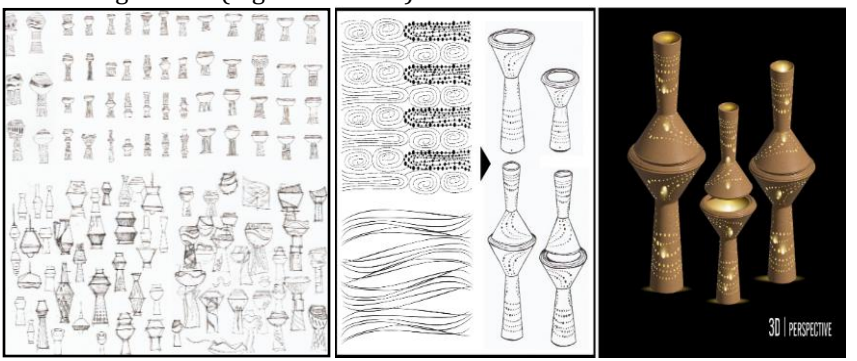

Figure 4. Pottery Forms and Pattern Designs Based on the Identity of Ban Kruat Community

Figure 5. Coiling Method and the Developed Prototype Pottery

For the purpose of knowledge transfer to community enterprises in Ban Kruat District, Buri Ram, Thailand, the researchers: 1) illustrated an appropriate clay mixing technique for pottery shaping, 2) demonstrated hand-forming methods rooted in traditional practices, and 3) showcased pattern designs reflecting the cultural identity of the Ban Kruat archaeological site (Figure 6). The demonstration aimed to transmit pottery knowledge, enabling local residents to inherit this cultural heritage, thereby supporting their ability to achieve economic success and generate income for themselves and their families.

[A: Lecture] [B:Demonstration] [C:Trials]
Figure 6. Demonstration of Pottery Production using Ancient Techniques to Community Enterprises

To assess the satisfaction of residents of Ban Kruat District residing near the Ban Kruat archaeological site, data were collected from 100 participants. Of these, 34 were male (34%) and 66 were female (66%), as illustrated in Figure 7.

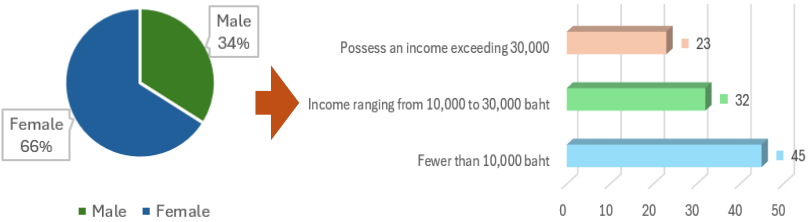

Figure 7: Sample General Information

As shown in Figure 7, 45 participants (45%) reported a monthly income below 10,000 baht, 32 participants (32%) earned between 10,000 and 30,000 baht, and 23 participants (23%) had an income exceeding 30,000 baht. The results of the satisfaction evaluation are presented in Table 5.

Table 5

The Evaluated Satisfaction with the New Pottery of the Inhabitants in Ban Kruat District

Code	Item	Mean	S.D.	Satisfaction Level
	Identity			
Ide1	The pottery forms indicate the prehistoric age.	4.49	0.628	High
Ide2	The identity of the pottery forms and shapes is outstanding.	4.53	0.674	Highest
Ide3	The pottery patterns indicate the local identity.	4.61	0.601	Highest
Ide4	The pottery colours indicate the local identity.	4.54	0.610	Highest
Ide5	The pottery indicates the unique identity.	4.56	0.574	Highest
Ide6	The pottery can communicate emotions and feelings.	4.60	0.586	Highest
Ide7	The pottery indicates cultural wisdom.	4.62	0.616	Highest
Ide8	The pottery can create income for the community.	4.59	0.588	Highest
Ide9	The pottery indicates the identity of Ban Kruat archaeological site.	4.63	0.562	Highest
Ide10	The identity of the pottery reflects the culture of the community.	4.61	0.567	Highest
	Satisfaction with the Identity	4.58	0.601	Highest
	Aesthetics			
Aes1	The pottery colours are fascinating.	4.56	0.656	Highest
Aes2	The pottery forms, patterns, and colours are unified.	4.58	0.589	Highest
Aes3	The pottery forms are outstanding.	4.60	0.636	Highest
Aes4	The pottery shapes are fascinating.	4.53	0.627	Highest
Aes5	The pottery forms are balanced.	4.50	0.628	Highest
Aes6	Compositions of the pottery patterns are balanced and fascinating.	4.49	0.611	High
Aes7	The pottery forms and patterns conform to ancient Khmer civilization.	4.55	0.609	Highest
Aes8	The pottery patterns indicate the influences of ancient Khmer culture.	4.52	0.611	Highest
Aes9	The pottery forms are similar to those found in the community.	4.59	0.570	Highest
Aes10	The pottery decoration techniques are suitable for the skills of potters in the community enterprises.	4.59	0.621	Highest
	Satisfaction with Aesthetics	4.55	0.616	Highest
	Material			

Mat1	Using local clay conforms to the concept of a circular economy.	4.55	0.609	Highest
Mat2	Using the abundant local clay can reduce production costs.	4.54	0.593	Highest
Mat3	The clay used for pottery is strong and firm.	4.51	0.628	Highest
Mat4	The clay used for pottery production is unique.	4.60	0.586	Highest
Mat5	The properties of the new clay are suitable for pottery production.	4.51	0.611	Highest
Mat6	The pottery can communicate emotions and feelings.	4.53	0.559	Highest
Mat7	The pottery forming method is suitable.	4.55	0.592	Highest
Mat8	The pottery production process indicates an extension of original wisdom.	4.59	0.570	Highest
Mat9	The pottery production is similar to the prehistoric production techniques.	4.52	0.577	Highest
Mat10	The physical features of the new clay are suitable for production.	4.54	0.558	Highest
Mat11	The pottery development in this research conforms to the current trends.	4.58	0.572	Highest
	Satisfaction with Material	**4.55**	**0.587**	Highest

Exploratory Factor Analysis (EFA)

a) The data quality was assessed according to the criteria outlined by ElNakib et al. (2021):

Adequacy test: The dataset was deemed suitable for EFA, with KMO = 0.905 and MSA ranging from 0.865 to 0.949.

Correlations: The dataset was appropriate for factor analysis, as indicated by Bartlett's Test of Sphericity (sig. = .00).

Communality: The observed variables demonstrated sufficient common variance to be grouped into factors, with communalities ranging from 0.595 to 0.830.

b) Factor analysis was conducted using principal component analysis (PCA) with varimax rotation, considering factor loadings greater than 0.50. Of the 31 observed variables, 20 satisfied the EFA criteria. These variables were classified into three components, accounting for a cumulative variance of 72.201%. The detailed results are as follows:

Component 1 – Identity: Comprised eight observed variables (Ide7, Ide3, Ide10, Ide9, Ide4, Ide8, Ide5, Ide2), explaining 15.367% of the variance.

Component 2 – Aesthetics: Comprised six observed variables (Aes7, Aes9, Aes2, Aes1, Aes4, Aes6), accounting for 14.659% of the variance.

Component 3 – Material: Comprised six observed variables (Mat5, Mat3, Ide6, Mat2, Mat1, Mat11), contributing 12.171% of the variance.

Table 6

Rotated Component Matrix

	Component	Component			Communality
		1	2	3	
	Component 1 Identity				
Ide7	The pottery indicates cultural wisdom.	0.763			0.774
Ide3	The pottery patterns indicate the local identity.	0.694			0.690
Ide10	The identity of the pottery reflects the culture of the community.	0.689			0.601
Ide9	The pottery indicates the identity of Ban Kruat archaeological site.	0.686			0.803
Ide4	The pottery colours indicate the local identity.	0.682			0.693
Ide8	The pottery can create income for the community.	0.679			0.684
Ide5	The pottery indicates the unique identity.	0.659			0.675
Ide2	The identity of the pottery forms and shapes is outstanding.	0.577			0.595
	Component 2 Aesthetics				
Aes7	The pottery forms and patterns conform to ancient Khmer civilization.		0.760		0.800
Aes9	The pottery forms are similar to those found in the community.		0.759		0.829
Aes2	The pottery forms, patterns, and colours are unified.		0.756		0.803
Aes1	The pottery colours are fascinating.		0.722		0.695
Aes4	The pottery shapes are fascinating.		0.712		0.755
Aes6	The compositions of the pottery patterns are balanced and fascinating.		0.684		0.778
	Component 3 Material				
Mat5	The properties of the new clay are suitable for pottery production.			0.780	0.733
Mat3	The clay used for the pottery is strong and firm.			0.735	0.719
Ide6	The pottery can communicate emotions and feelings.			0.673	0.800
Mat2	Using the abundant local clay can reduce production costs.			0.618	0.691
Mat1	Using local clay conforms to the concept of a circular economy.			0.584	0.619
Mat11	The pottery development in this research conforms to the current trends.			0.534	0.673
	Sum of Squared Loadings (Eigenvalue)	5.211	5.113	4.116	14.440
	Percentage of Trace	26.057	25.563	20.581	72.201

Confirmatory Factor Analysis (CFA)

CFA was conducted in three stages:

Measurement Model

The latent constructs, namely identity, aesthetics, and material, were evaluated for their measurement properties (ElNakib et al., 2021; Kamalipour et al., 2014).

Table 7

Model's Goodness-of-Fit Indexes (Measurement Model)

Model-Fit Criterion	Acceptable Level* (ElNakib et al., 2021)	Model Level IDE	AES	MAT
χ^2	-	5.770	2.245	1.593
df	-	9	2	2
χ^2/df	< 3.00 (Kamalipour et al., 2014)	0.641	1.122	0.797
P-Value	> 0.05 (ElNakib et al., 2021)	0.763	0.326	0.451
CFI	> 0.99 (ElNakib et al., 2021)	1.000	0.999	1.000
TLI	> 0.99 (ElNakib et al., 2021)	1.015	0.997	1.006
RMSEA	< 0.08 (ElNakib et al., 2021)	0.000	0.035	0.000

Based on the 20 observed variables that satisfied the EFA criteria, testing of all five models indicated that 14 observed variables met the CFA requirements.

For the measurement model of identity, six observed variables were retained: Ide9, Ide8, Ide7, Ide3, Ide4, and Ide10, with standardized factor loadings of 0.932, 0.812, 0.796, 0.783, 0.749, and 0.700, respectively.

For aesthetics, four observed variables were included: Aes9, Aes7, Aes6, and Aes1, with standardized factor loadings of 0.914, 0.865, 0.833, and 0.751, respectively.

For material, four observed variables were retained: Mat2, Mat5, Mat11, and Mat3, with standardized factor loadings of 0.867, 0.816, 0.766, and 0.745, respectively.

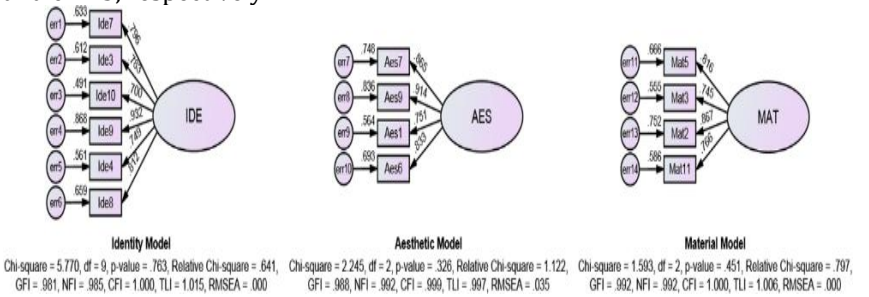

Figure 8. Analysis of the Three Latent Variable Measurement Models

First-Order CFA of the Three Latent Variables

The model fit indices were $\chi^2 = 74.349$, df = 65, p = 0.200, $\chi^2/df = 1.144$, GFI = 0.911, NFI = 0.939, CFI = 0.992, TLI = 0.988, and RMSEA = 0.038, indicating that all indices satisfied the recommended criteria. Convergent

validity was confirmed for the measurement models: Identity (CR = 0.911, AVE = 0.633), Aesthetics (CR = 0.911, AVE = 0.718), and Material (CR = 0.890, AVE = 0.670). Based on these model fit indices, all criteria were met ElNakib et al. (2021), demonstrating that each latent variable possessed convergent validity and was suitable for subsequent analysis.

Second-Order CFA

The model fit indices were $\chi^2 = 74.349$, df = 65, p = 0.200, $\chi^2/df = 1.144$, GFI = 0.911, NFI = 0.939, CFI = 0.992, TLI = 0.988, and RMSEA = 0.038, indicating that all indices satisfied the recommended criteria (ElNakib et al., 2021). Standardized factor loadings for all variables were significant at the 0.001 level (p < 0.001). Therefore, it can be concluded that the three components collectively influenced satisfaction with the development of pottery based on the identity of the Ban Kruat archaeological site for community enterprises (Giotsa & Kyriazos, 2019). The observed variables for each factor are prioritised as follows:

Aesthetics (CR = 0.971): The observed variables comprised "The pottery forms are similar to those found in the community" (Aes9, λ = 0.882), "The compositions of pottery patterns are balanced and fascinating" (Aes6, λ = 0.868), "The pottery forms and patterns conform to ancient Khmer civilisation" (Aes7, λ = 0.860), and "The pottery colours are fascinating" (Aes1, λ = 0.776).

Identity (CR = 0.912): The observed variables included "The pottery indicates the identity of Ban Kruat archaeological site" (Ide9, λ = 0.948), "The pottery can create income for the community" (Ide8, λ = 0.811), "The pottery indicates cultural wisdom" (Ide7, λ = 0.785), "The pottery patterns indicate the local identity" (Ide3, λ = 0.768), "The pottery colours indicate the local identity" (Ide4, λ = 0.747), and "The identity of the pottery reflects the culture of the community" (Ide10, λ = 0.692).

Figure 9: The Final Model Features the Standardized Path Coefficients and Factor Loadings

Material (CR = 0.888): The observed variables included “The pottery development in this research conforms to current trends” (Mat11, λ = 0.896), “Using the abundant local clay can reduce production costs” (Mat2, λ = 0.890), “The properties of the new clay are suitable for pottery production” (Mat5, λ = 0.762), and “The clay used for the pottery is strong and firm” (Mat3, λ = 0.711).

Table 8

The Resulting Model's Standardized Regression Weights and Squared Multiple Correlation Estimations

Path	Items	β	S.E.	C.R.	R^2	*p*
SAT ---> AES	-	0.971	-	-	0.942	-
SAT ---> IDE	-	0.912	0.097	9.756	0.831	***
SAT ---> MAT	-	0.888	0.099	9.320	0.789	***
MAT---> Mat2	Using the abundant local clay can reduce production costs.	0.890	-	-	0.792	-
MAT---> Mat5	The properties of the new clay are suitable for pottery production.	0.762	0.095	9.329	0.580	***
MAT---> Mat3	The clay used for the pottery is strong and firm.	0.711	0.101	8.570	0.505	***
MAT---> Mat11	The pottery development in this research conforms to the current trends.	0.896	0.103	9.470	0.802	***
AES ---> Aes6	The compositions of the pottery patterns are balanced and fascinating.	0.868	-	-	0.753	-
AES ---> Aes7	The pottery forms and patterns conform to ancient Khmer civilization.	0.860	0.085	11.654	0.740	***
AES ---> Aes9	The pottery forms are similar to those found in the community.	0.882	0.078	12.214	0.777	***
AES ---> Aes1	The pottery colours are fascinating.	0.776	0.099	9.732	0.602	***
IDE ---> Ide9	The pottery indicates the identity of Ban Kruat archaeological site.	0.948	-	-	0.898	-
IDE ---> Ide7	The pottery indicates cultural wisdom.	0.785	0.079	11.347	0.616	***
IDE ---> Ide3	The pottery colours indicate the local identity.	0.768	0.082	10.642	0.590	***
IDE ---> Ide10	The identity of the pottery reflects culture of the community.	0.692	0.084	8.783	0.478	***
IDE ---> Ide4	The pottery colours indicate the local identity.	0.747	0.085	10.057	0.557	***
IDE ---> Ide8	The pottery can create income for the community	0.811	0.074	12.098	0.657	***

Table 5 summarises the demographic characteristics of the 100 registered community enterprise entrepreneurs, emphasising age, sex, and experience in pottery production. Table 6 presents the results of the confirmatory factor analysis (CFA), demonstrating the reliability of the three identified factors—Aesthetics, Identity, and Material—with high factor loadings. Table 7 displays the correlation coefficients among the variables, indicating a strong positive association between the aesthetic quality of the pottery and community satisfaction. Semi-structured interviews, summarised in Table 8, provided insights into the transfer of skills across generations and its influence on the community. Figures 8 and

9 illustrate the pottery characteristics derived from the Ban Kruat archaeological site, emphasising design features and physical properties such as strength and firing performance. Collectively, these tables and figures underscore the significance of cultural capital in product innovation, highlighting the interrelationship between the heritage of pottery and the community.

Discussion

This study on the identity of pottery from the Ban Kruat archaeological site, Buri Ram, Thailand, was conducted in the area of Wat Pa Phra Sabai temple, where prehistoric pottery was excavated. The site served as a major pottery source during the Bronze Age and Iron Age. In Ban Kruat District, clay is abundant, exhibiting a characteristic black-gray colour due to its mineral content. Additionally, the clay contains minerals from volcanic eruptions that occurred over one million years ago, providing high strength. Consequently, potters are able to create wares with flared rims and rounded bottoms. Ancient potters employed a coiling method prior to firing in kilns fuelled by dry straw. Contemporary pottery production and firing techniques resemble those used historically in Sukhothai City, Phra Nakhon City, and Phimai City, all of which were major administrative centres in Southeast Asia.

Pottery production utilised a mixture of 100% Ban Kruat clay combined with 50% pumice dust at a 2:1 ratio. This mixture produced black-brown clay, characteristic of Ban Kruat pottery in terms of colour, and was easily shaped using the coiling method. When fired at 1,200 °C, the clay exhibited 2.78% water absorption and a strength of 118.85 kg/cm^2. Post-firing, amorphous silica became integrated into the clay structure, resulting in higher strength and lower water absorption. These properties contributed to the distinctive identity of Ban Kruat pottery, differentiating it from wares produced with clay from other sources in terms of colour, texture, and durability.

For knowledge transfer of the new Ban Kruat pottery production to community enterprises in Ban Kruat District, Thailand, a participatory action research approach was applied. Community members and small enterprises collaborated in developing the clay and designing pottery forms until prototypes were produced in accordance with the Thai Community Product Standards (TCPS). The process comprised four stages: 1) planning, 2) action and utilisation, 3) observation, and 4) reflection. This participatory approach contributed to the preservation of ancient pottery practices within the community. Furthermore, younger generations gained practical knowledge, enabling them to generate income through pottery production and distribution, thereby supporting sustainable occupational and economic development for local residents.

Regarding satisfaction among Ban Kruat community members and small enterprises with the new pottery, the results were as follows:

1. Satisfaction with Identity: Community enterprises reported the highest satisfaction with the identity of the new pottery, attributed to its black-gray colour, high strength, and low water absorption, which contributed to product quality and market demand. These findings align with the concept of generating economic opportunities in rural Thai communities through pottery innovation (Suvittawat, 2021). Knowledge gained from clay development can be transferred to other rural areas, supporting grassroots economic growth and promoting sustainable development while reducing long-term social inequality.

2. Satisfaction with Aesthetics: Enterprises expressed the highest satisfaction with the aesthetic quality of the pottery, as hand-forming techniques produced patterns reflecting Bronze Age and Iron Age pottery, capturing the lifestyle, beliefs, and culture of Ban Kruat Community, Buri Ram, Thailand. This aligns with the principles of a creative economy Piromgarn et al. (2023), which relies on cultural capital to strengthen grassroots economies. Technological support was used to enhance innovation while providing economic value for community members.

3. Satisfaction with Material: Enterprises reported the highest satisfaction with the material properties of the new pottery. The Ban Kruat clay–pumice mixture at a 2:1 ratio, shaped using the coiling method, resulted in pottery with high strength and low water absorption. These characteristics align with traditional pottery production techniques in Southeast Asia (Pryce & Higham, 2025). The high iron content in the clay produces dark brown to black-gray shades, consistent with the identity of clay in the lower Northeast region of Thailand during the Bronze and Iron Ages (Egwutvongsa, 2021).

Community feedback identified three factors influencing satisfaction with pottery development based on the Ban Kruat archaeological site, ranked in order of influence: aesthetics, identity, and material. These findings correspond to the principles of a creative economy Kijmongkolvanich et al. (2023) and Thai pottery design conventions (Namjaidee et al., 2010). Sustainable development for rural potters depends on promoting knowledge across three dimensions: 1) community history, 2) community resources, and 3) local ways of life and culture. This body of knowledge supports sustainable community development and has led to positive societal changes in Ban Kruat, including knowledge transfer for pottery innovation using local resources to generate income. Cultural capital and historical narratives were applied to develop community products, creating a sustainable production process aligned with circular economy principles (Emami et al., 2024).

The relationship between pottery heritage, sustainability, and innovation has been highlighted in numerous studies. Drob et al. (2024) emphasise the value of cross-disciplinary approaches in examining prehistoric raw materials and technologies for modern innovation. Gaitán et al. (2025) advocate collaboration between creative industries and museums to promote sustainable development in cultural heritage sectors. White and Adu-Ampong (2024) show that authentic intangible cultural heritage enhances tourism experiences and local economies. Antunes and Nunes (2025) recommend participatory design practices to engage communities and strengthen traditional craftsmanship. Lőrincz et al. (2023) examine consumer behaviour, noting increasing demand for authentic and creative handmade products. Gu et al. (2025) demonstrate that cross-cultural interactions, such as in blue-and-white porcelain, drive innovation in design and artistic development. Luekveerawattana (2024) highlights the need to navigate external factors to enhance innovation in cultural heritage tourism. Kofler and Walder (2024) underscore the role of technological progress in advancing the crafts industry, advocating a forward-looking perspective on traditional processes. Collectively, these studies illustrate that pottery and craft practices are critical for preserving cultural identity while promoting economic viability, flexibility, and innovation in increasingly globalised contexts.

Conclusion

The study explored the relationship between pottery heritage, collective action, and creative innovation in the Ban Kruat community, Thailand. It examined how local pottery traditions shape individual and group identity, informing sustainability and cultural change in a modern economy. Using a qualitative approach with ethnography, interviews, and artefact observation, the research captured both tangible and intangible aspects of pottery heritage. Findings show that Ban Kruat pottery functions as a cultural marker, with durability, aesthetics, and material qualities enhancing local entrepreneurs' satisfaction. The study highlights the role of intergenerational skill transfer and collaborative production in preserving cultural knowledge while fostering heritage-based innovation, which strengthens economic resilience and social cohesion. The study further highlights the value of promoting similar initiatives in other regions. For future research, exploring the intersections between pottery heritage and other cultural expressions could provide deeper insights into local creativity. Additionally, examining how pottery artisans adapt to global market pressures without compromising cultural identity would inform strategies for sustainable cultural and economic development. Understanding these dynamics will advance knowledge of the connections between culture, identity, and innovation, contributing to broader

discussions on sustainable community development in a globalised context.

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