

A Metadata Schema for Murals in Northeastern Thailand

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Received: April 23, 2022

Revised: August 9, 2022

Accepted: October 3, 2022

Abstract

This article explores the development of a metadata schema for temple murals in Northeastern Thailand, a region also known as Isan. It has the following objectives: 1) to analyze the content, context, and structure of the murals of northeastern Thailand, and 2) to develop a metadata schema for the management of digitized murals to increase efficiency in search, access, management, and use. The research was conducted through the analysis of murals, based on three features of the information approach. The first is content, which consists of the content group, name of the murals, and the era of the mural, painter, and inscriptions. The second is context, consisting of registration of information on the mural's restoration, and the owner and location of the painting. The third feature is structure, which includes art form, style, period, type, location, and painting sequence. The development of the metadata schema was conducted using the metadata lifecycle model, which consists of the following three steps: 1) conducting an information content analysis; 2) creating metadata requirements; and 3) developing a metadata schema. The metadata schema development adopted the functional requirements for metadata standards from the standard Visual Resources Association (VRA) Core. Research findings illustrate that the resulting metadata has the following 19 elements: ID type of record, agent, date, description, inscription, location, right, style period, subject, technique, text ref, title, work type, conserve, position, structure, type, sequencing, and date/time.

Keywords: metadata schema, murals' metadata, features of information, VRA Core, digital humanities

Introduction

Murals throughout the world are part of cultural heritage and national art. A painting is a work created to be beautiful and represent an artist's ideas, expertise, precision, technical ability, and admiration. Murals differ from each other in composition, narrative imagination, and artistic ability. The artist will express his imagination in paintings or cause abstract things to become concrete (UNESCO, 2017). In addition, murals are crucial evidence of history because they tell stories, such as folktales, beliefs, religion, culture, and historic events (Samosorn, 1989). Each artist has a unique way of communicating (Plangdeesakul, 2011). Viewed generally from the perspective of the local history of art in Isan, the art of the region has been influenced by the art of the neighboring countries of Laos and Cambodia. The art of Laos and Cambodia has, in turn, been influenced by that of India and Siam. The art of Isan has been influenced by all of these cultures. Buddhist murals of Northeast Thailand are a perfect complement to an understanding of Isan arts and culture. Murals appear in every region in Thailand and are valuable in art and culture (Fine Arts Department, 2015). More research on Thai art outside of the major cities is considered necessary (Brereton and Yencheuy, 2010). Despite the tangible cultural benefits, mural paintings face the threat of irreparable damage as unique heritage artifacts. Unpredictable climate conditions, vandalism, lack of appreciation of the social history and the arts, loss of cultural integrity through changes in societal tastes, as well as authorities' ambivalence and lack of critical commitment to heritage preservation have contributed to the need to sustain and preserve murals (Poon, 2016). The conservation of murals is a complex process that involves the study of the materials, painting technique, history of the painting, artist's intention, and the social and cultural context.

In an effort to bridge the knowledge gap in this field, this article identifies the value of art as cultural heritage information. It can provide insight into the history, culture, and values of a society. It can also be used to teach future generations about the past. Additionally, art can be

used to promote cross-cultural understanding and respect. At present, cultural heritage information (CHI) is an issue that is beginning to receive more attention. For example, both nationally and internationally, the International Federation of Library Associations and Institutions has formulated cultural heritage issues into four strategic directions according to the strategic plan of IFLA (2016-2021) (International Federation of Library Associations and Institutions, 2016: 3-8). The plan emphasizes supporting the library and information services sector and working closely with a network of cultural heritage partners. Its goal is to safeguard cultural heritage in diverse forms, including traditional, historical, indigenous, and contemporary expressions. Moreover, it aims to achieve optimal coordination of cultural heritage activities (Blake, 2014).

There are many methods to preserve murals and cultural heritage. Academics have tried to find a way to access and retrieve this knowledge without destroying the original mural through management via information technology. The study's previous research found that the use of information technology can help to manage and preserve murals and other forms of cultural heritage by creating a digital copy which can be used to create a 3D model. The use of information technology can also help to create a database of the mural or other forms of cultural heritage, which can be used to track changes over time. Technologically-mediated heritage has been discussed because of its importance in preserving heritage and culture by using digital technology in storing data, presenting, and publishing information through the media. This technology preserves and continues to provide knowledge for the next generation (Chaichuay et al., 2017; Na Songkhla, 1985).

The present study is one of digital humanities research. The organization of digital humanities research is the process of creating and maintaining a system for storing and retrieving information. This process includes the development of metadata standards, the creation of digital repositories, and the management of digital collections (Tuamsuk, Chansanam, Chaikhambung and Kaewboonma, 2018). Information access is the ability to identify, retrieve, and use information

effectively. Essentially, metadata is data that describes other data to increase its usefulness and meaning. Cultural heritage institutions often use metadata to preserve and manage digital collections. For example, a digitized photograph (data) might have an associated title, description, and date (metadata). If this metadata did not exist, the photograph would have less meaning; a person viewing it would not know who was in the photo, why it was taken, or what it showed. Without metadata, items within cultural heritage sites or special collections would be less visible, less protected, and less valuable to researchers. Moreover, cultural heritage objects are often irreplaceable and thus their metadata is important for ensuring that they can be properly identified and cataloged. Additionally, metadata can help to provide context for an object and can aid in its preservation (Dobreva and Ikonomov, 2009; National Information Standards Organization-NISO, 2004).

Metadata is “data about data,” that is, structural, descriptive, or narrative information associated with information resources, objects, or systems. The purpose of metadata is to provide information that can be used to help identify, manage, and use information resources (Haynes, 2018). A description of informational resources must include three key features: 1) content, which is the story recorded in the resource; 2) context, which is basic information that describes the meaning of a document, such as how it is or was created and preserved and where it is found; and 3) structure, which is information related to the external appearance and management of the content of resources, such as location, size, etc. (Baca, 2008; Zeng and Qin, 2008).

Metadata refers to the structural, descriptive, or narrative information associated with information resources, objects, or systems; it allows this information to be managed, searched, and used. Therefore, metadata development is necessary. Having metadata that is appropriate for the characteristics of the resource will assist in searching, ensure that the information is useful, and preserve it effectively. Consequently, the developed metadata serves as a standard information structure for the management of Thai murals. This metadata will also enable Thai cultural heritage and wisdom to be linked with those of other countries

via the internet (Metadata Architecture and Application Team -MATT, 2008).

Research Objectives and Methods

The research objectives are to analyze attributes in the content, context, and structure of murals and develop a metadata schema to manage temple murals in Northeastern Thailand. The study employed R&D and qualitative research approaches as the basis for the development of metadata. In supporting data integration across digital repositories, a metadata integration framework is defined based on the Metadata Lifecycle Model (MLM). MLM, proposed by the Metadata Architecture and Application Team, is a methodology involving a ten-step process by which digital library projects can design and implement metadata provision. MLM emphasizes the iterative processes from requirement and content analysis and system specification to metadata system and service evaluation (MATT, 2008; Buranarach et.al, 2022). The framework consists of four steps analyzing information content, performing a user study, creating metadata requirements, and developing the metadata schema. These steps are explained below.

1) The analysis of the information content has three components. The first is document analysis, which analyzes the physical structure and types of content in the murals. The second component is content analysis from mural paintings in 19 temples in the Northeast Region registered as historic sites by the Fine Arts Department, Ministry of Culture (Fine Arts Department, 2015). Finally, the third component is in-depth interviews with experts. This method confirms information gained from document analysis and data from studies of real murals. The information content of a mural can vary depending on the artist's intent and the viewer's interpretation. However, some common elements that can be analyzed include the colors, shapes, and symbols used in the mural. The artist's use of these elements can convey messages about the subject matter of the mural, as well as the artist's own feelings and thoughts.

2) The second step is the study of the behavior of the users of mural information. This research area investigates how people interact with murals. It can include how people view murals, how they react to them, and how they use them. This step selected key informants, using snowball sampling. The qualifications of the main informants include experience in using murals for work in the course of study according to their interests. The interview continues until the data is stable, and then the investigator ends it. The tool is a semi-structured interview based on information behavior (Wilson, 2000), and the outcome is primary data about user requirements for a digital collection of murals.

3) The third step is creating the metadata requirements for murals. The researcher determined the method of developing metadata using the adjustment method from the Visual Resources Association (VRA) Core. The VRA Core data standard is a valuable tool for the description of works of visual culture, as well as the images that document them. Visual culture can include things such as paintings, drawings, sculptures, architectural designs, and photographs. Additionally, it can include book art, decorative art, and performance art. The international metadata standard is used by museums and cultural heritage organizations around the world to manage metadata for objects containing cultural heritage resources.

4) The fourth step is developing the metadata schema. This step compares items in the table format. It finds elements consistent with the user's needs and groups the elements according to the meaning of the metadata. It reduces the duplication of those metadata elements and adds new elements to discover. This step, which uses the concept of an application profile, consists of metadata elements drawn from one or more metadata schemas combined into a compound schema by implementers, and optimized for a particular local application (Heery and Patel, 2000). An application profile (AP) may also be based on one single schema but tailored to different user communities (Nevile and Méndez, 2015). For example, a schema for a library catalog may be used to support a variety of APs, each of which is designed to support a specific user community. The APs may be based on the same schema

but may have different metadata elements, different vocabularies, different encoding rules, different structure, and so on.

Research Results

Analyzing the Information Content

Isan murals can be classified into two eras, the prehistorical and the historical periods. The prehistoric paintings appear on cave walls. They show the centrality of the hunt in the economy and the symbolism of hunting and gathering people. Paintings in the historical period portray Buddhist subjects.

Mural art is a vital medium for teaching Buddhist values (Na Songkhla, 1985). The study found that the paintings gained inspiration from literature, beliefs, and faith in Buddhism. Isan murals, known as *hup taem* in the local language, differ greatly from one temple to another depending on their location. As Samosorn (1989) pointed out, there are three distinct stylistic clusters: the Mekong River cluster, the central Isan cluster, and the southern Isan cluster. Those in Nakhon Ratchasima province are very different from the others and more closely resemble murals in the Central Region. But in all cases the content is related to Buddhism, whether it is about the Buddha's past life stories (*Jatakas*), scenes from the life of the Buddha, or various Buddhist stories from local literature (Polson, 2012). This local literature, like that of Lao PDR, comes from the Lao tradition. The most frequently seen stories are the *Vessantara Jataka*, which is the story of the penultimate life of the Buddha; the Lao *Phra Lak Phra Ram*, which is the Buddhist version of the Rama epic; and *Sang Sinchai* (known in Isan as *Sinsai*), a Lao epic, which is believed to be a local *Jataka*. Local customs, traditions, and lifestyles provide the background or setting. These valuable themes have motivated artists to create murals on temples throughout Thailand (Buddasarn, 2003). Aside from containing stories, murals are educational works of art that reveal much of past society. They reflect the status of the artist and the position of the temples as centers of economy, culture, and politics (Cate, 1998).

The colors used in Isan murals are primarily blue and reddish brown, as well as yellow, and green on a unique white or off-white background, which resembles a shadow play screen (Brereton and Yencheuy, 2010, 45). By contrast, the colors of Central Thai murals include red, blue, yellow, and green on a dark background.

There are also noteworthy differences in the composition of the murals. In central Thai murals, the upper portion of the wall usually is reserved for royalty, heroic characters, and deities; the middle is devoted to the basic story; and the lower part of the wall depicts common people in everyday activities (Trachoo, Laoakka and Wannajun, 2014). However, Isan murals, especially those in the heartland provinces of Khon Kaen, Maha Sarakham, Kalasin, and Roi Et, do not adhere to this pattern. Rather, the landscape is a democratic one in which figures of ordinary people are found at all levels and their participation in the stories and rituals and constitutes an integral part of the composition (Brereton and Yencheuy, 2010: 47). Still another difference in composition is that Isan murals give the appearance of a cloth scroll painting that has been hung on up the walls; the story progresses around the building rather than being confined to one wall (Brereton and Yencheuy, 2010: 48).

The size of murals depends on the size of the wall on which they are painted. The size of the wall usually dictates the size of the mural. The age of murals can be determined by the style of the mural and the materials used. In the past, mural artists used mostly natural colors for paintings, although they also used some chemical colors as well.

Analysis of Features for Identification of Murals Metadata Elements

The document analysis examined the physical structure and content of the murals. The study explores the basics of the characteristics of murals and analyzes the features of information: content, context, and physical structure (Baca, 2008). The sources of information are mural paintings in 19 temples in the northeast region, mentioned above, that are shown in Table 1.

Table 1 List of temples and data sources

Temple name	District	Province
Pathum Kongka	Pak Thong Chai	Nakhon Ratchasima
Na Phra That	Pak Thong Chai	Nakhon Ratchasima
Khok Sisaket	Pak Thong Chai	Nakhon Ratchasima
Borom Khongkha	Phutthaisong	Buriram
Malapirom	Pho Chai	Roi Et
Tri Phom Kana Chan	Suvarnabhumi	Roi Et
Thung Si Mueang	Mueang Ubon Ratchathani	Ubon Ratchathani
Na Khwai	Mueang Ubon Ratchathani	Ubon Ratchathani
Chai Si	Khon Kaen	Khon Kaen
Sanuan Wari Phatthanaram	Ban Phai	Khon Kaen
Machima Withayaram	Ban Phai	Khon Kaen
Udom Pracharat	Mueang Kalasin	Kalasin
Phra That Phanom	That Phanom	Nakhon Phanom
Pho Kham	That Phanom	Nakhon Phanom
Phra Si Maha Pho	Wan Yai	Mukdahan
Phra That Choeng Chum	That Choeng Chum	Sakon Nakhon
Thep Phon Praditharam	Wiang Khuk	Nong Khai
Mahathat	Chiang Khan	Loei
Pho Chai	Na Kaew	Loei

The analysis of murals produced the following results.

Content

Content is the data analyzed and interpreted from the story within the resources. The content of the murals can be classified into five elements, as follows.

1) The content group of the murals is the main content that appears in the murals. The murals may depict various aspects of the history of a city, including its founding, its growth, and its culture. The theme may be the life of the Buddha, *Jatakas*, riddles, way of life, local literature, etc.

2) The name of the mural is the name given as a substitute for the mural. It usually refers to the name of the temple in which the mural appears.

3) The era of a mural is the year the mural was painted. It is presented as a period in the Common Era or in some places, by a historical age.

4) The painter, owner, or creator of the mural is the person who created it.

5) An inscription in a mural is the text that appears in it. It can include a message about the story, creator, or any other topic.

Context

Context is the data that identify the origin and the setting environments of murals. There are four elements as follows:

1) Mural registration is information registered and dated in the Thai Government Gazette.

2) Mural restoration is information on the date of restoration of the mural and it indicates the location of the restoration.

3) The owner of the painting is the name of the temple where the mural is located.

4) The location of the painting is the building on which the mural is found in the temple, such as the sim or audience hall.

Structure

Structure refers to the visual appearance of the painting and the handling of the content of the resource. It includes the six following categories:

1) The art form of a mural is a pattern established as a guideline for the creation of the work.

2) The style period of the mural is a production style, the name of the historical era, the school of the production, or any other term representing the nature of the work.

3) Structure of murals, which consists of three parts:

3.1) The main image is the primary image of the whole work; it is often centered.

3.2) The secondary image is the composite image of the main mural but is not positioned as prominent as the main image.

3.3) Sub images are other images. They are often painted for beauty or to make stories more realistic or engaging, such as forests, mountains, nature, houses, etc.

4) Types of murals

4.1) Pattern murals are paintings that present the beauty of a painting without a character or telling the story of any person or thing, such as a mythical animal, plant, etc.

4.2) Story murals are paintings with stories and characters. They also depict scenes, such as events from the Buddha's life, *Jatakas*, local literature, etc.

5) The location of a mural is the point where it was found, such as the ceiling, inside or outside wall of the ordination hall (*ubosot* or *sim* as it is called in Isan), around the windows or doors, etc.

6) The painting sequence of the murals includes three unique styles – scatter, grid, and content sequence.

Studying the Behavior of Mural Users

This study collected data from 15 users. The government agency responsible for data about murals defines 17 elements (Table 2). These elements are from the registration data list of the mural painting database system.

The study found that the users needed information providers for items that are useful for searching and accessing murals. Furthermore, they have suggested six elements that should be included in the information providers (Table 2). To access the desired contents and the physical murals, users required reasonable access points.

Table 2 Comparison of the elements from the information features and user study

The information features		Elements from information features of mural	Elements from user study	Elements from the registration data list
Content	Content	✓	✓	✓
	Title	✓		
	Name of temple		✓	
	Agent	✓		✓
	Inscription	✓		
	Description		✓	
	Date	✓	✓	✓
	Style Period	✓		✓

Table 2 Comparison of the elements from the information features and user study (cont.)

The information features		Elements from information features of mural	Elements from user study	Elements from the registration data list
Context	Number (id)		✓	✓
	Register	✓		✓
	Conserve	✓		✓
	Owner	✓		✓
	Location	✓		✓
	Project			✓
	Status of temple			✓
Structure	Technique	✓	✓	✓
	Structure	✓		
	Type	✓		
	Position	✓		✓
	Sequencing	✓		
	Pattern name			✓
	Notation			✓
	Textref			✓
	Date/time			✓

Creating the Metadata Requirements

1. Comparison of desired elements and selected metadata elements

In developing the metadata schema for the mural repositories, metadata elements were defined based on the VRA Core standard. Some VRA metadata elements were selected based on their appropriateness for the subjects of mural repositories because VRA Core is a metadata schema for describing the visual arts (Caplan, 2003). It is an internationally recognized standard and it has the advantage of being flexible to implement. It is possible to add or remove elements according to the nature of the resources in each collection. It is not necessary to use all the elements in the record. In addition, the selected elements from the

VRA Core were adopted together with new elements to ensure that the developed metadata schema could describe and enable users to access the needed information. Furthermore, the VRA Core schema facilitates future sharing of records, descriptive lists, original artwork, and photographs compiled in each agency's database. The VRA Core can be rendered as XML, allowing data to be encoded for use and control. It can transfer data through various software and file-sharing as XML and is compatible with other standards, such as CCO, CDWA, and Dublin Core.

The elements may come from one or more element sets, thus allowing a given application to meet its functional requirements by using metadata from several element sets, including locally defined sets (Devey and Marie-Claude, 2016; Nevile and Méndez, 2015). The murals metadata elements defined in this research result from comparing metadata elements and properties from the VRA Core elements, elements of the characteristics of murals, elements from the user study, and elements from the registration data list. The developed metadata was again compared with the elements of existing metadata schemas for finding the common specified attributes of the murals metadata. The metadata elements were extracted using the application profile (AP) by matching the VRA metadata elements and elements from information features of the mural with the user's metadata requirements. The significant attributes and their definitions appear in Figure 1 and Table 3.

Table 3 Comparison of elements and meanings based on VRA Core standards

Elements from VRA Core	Metadata mural composition requirements		
	Elements from information features of the mural	Elements from user study	Elements from the registration data list
Work, collection, or image (id)	-	Number (id)	Number (id)
Agent	Agent	-	Owner/Agent
Cultural context	-	-	-

Table 3 Comparison of elements and meanings based on VRA Core standards (cont.)

Elements from VRA Core	Metadata mural composition requirements		
	Elements from information features of the mural	Elements from user study	Elements from the registration data list
Date	Date	Date	Date
Description	-	Description	Notation
Inscription	Inscription	-	-
Location	Location	Name of temple	Location/Status of temple
Material	-	-	-
Measurements	-	-	-
Relation	-	-	-
Right	Register	-	Register
Source	-	-	Textref
StateEdition	-	-	-
StylePeriod	StylePeriod	-	-
Subject	Content	Content	Content/ Pattern name
Technique	Technique	Technique	Technique
Textref	-	-	Project
Title	Title	-	-
Worktype	Specific elements specify the type of WORK, COLLECTION, or IMAGE specified in the record. It is an element that cannot be eliminated.		

Nineteen elements are necessary for users of murals. Thirteen elements can be adapted from the VRA Core standard. There is a need to create six additional elements that the standards do not provide.

2. Developing the metadata schema

The structure of the created metadata divides the data units into two levels: the main component and the sub-element. The metadata requirements list for murals consists of 19 metadata elements. They are based on metadata elements from the VRA Core for the benefit of storing, accessing, publishing, and exchanging resources effectively. The metadata element for the mural contains the element's name and description.

The article will focus on Wat Chai Si as an example. While the wat was founded in 1900, the *sim* was built later, in 1922, and the murals were painted after its completion (Bunchayakorn, n.d.) Like the other temples in Isan, the *sim*'s walls are made of brick and lime plaster and are covered with murals on the exterior. However, Wat Chai Si is unique in two ways: its façade and the characteristics of its murals. The façade is a complex array of pilasters, false windows, and moldings resulting in a fragmented surface with many corners, all of which are covered with paintings. At various other temples in Northeast Thailand the murals tell one or, at most, two stories in a manner like a scroll being unrolled, with the plot developing in segments as one walks around the walls. However, at Wat Chai Si the murals appear to have no clearly defined narrative order and thus are challenging to interpret (Brereton, 2015, 4). Moreover, the paintings are less technically accomplished, as many of the figures are rough sketches or have odd proportion (Buchayakorn, Pimpakorn and Suwanakorn, 2019). It is also important to point out the exterior paintings are badly faded because the roof that was built to replace the original one is a steep Central Region design that does not provide any shade for the murals. The traditional Isan-style roof is referred to as the ‘bird-wing style,’ which is low-pitched and wide, in order to protect the murals from the rays of the sun.

However, while Wat Chai Si's murals lack the fine line drawing of those at Wat Machima Withayaram in Ban Phai district, Khon Kaen or Wat Pho Kham in That Phanom district, Nakhon Phanom, they are most memorable because of their explosive energy and idiosyncratic composition. The exterior is devoted primarily to scenes from the *Sinsai* epic, set in a background of local customs, as well as a few scenes of karmic sufferings in the Buddhist hells located at the entryway.

The metadata information of the mural painting of Wat Chai Si can be listed in Table 4.

Table 4 Description of data elements in metadata for murals in Northeastern Thailand

Element 1	
Name	Identifier (Work, Collection, or Image) Work = An identifier code for the mural Collection = An identifier code for a collection of murals. Image = An identifier code for an image of murals. [Definitions: A choice of one of three elements, WORK, COLLECTION, or IMAGE, defines a VRA 4.0 record as describing a WORK (a built or created object), a COLLECTION (an aggregate of such objects), or an IMAGE (a visual surrogate of such objects.)]
Definition	An identifier code for each mural stored in the system, using the Roman alphabet mixed with integral numbers. A Uniform Resource Identifier (URI) can also be applied as an identifier for murals located on the Internet.
Format	Numbers and/or letters
Example	Work = Murals of Wat Chai Si Collection = Wat Chai Si 01 Image = Wat Chai Si 01_01
Element 2	
Name	Agent
Definition	Individual or corporate body who created it. If there is more than one owner, sub-elements can be added by defining their attributes and roles.
Format	Text
Example	2.1 Attribute = Local folk art 2.2 Culture = Thailand 2.3 Date = - 2.4 Name = Thong Thipcha 2.5 Role = Painter
Note	For Thai creators, use “first name and last name” as indicated in the RDA standards. For foreign creators, use “last name, first name.” For an anonymous creator, record its appearance. You can enter more than one value, clearly defining the attributes and roles of each value.
Element 3	
Name	Date
Definition	Date of production in A.D. has subcomponents earliestDate and latestDate.
Format	Text or numbers. In the case of specifying a number, day, month, and year. Use the ISO 8610 data standard date format: YYYY, YYYY-MM, or YYYY-MM-DD as appropriate.
Example	3.1 earliest Date = B.E. 2460 or C.E. 1917 3.2 latest Date = B.E. 2466 or C.E. 1923

Table 4 Description of data elements in metadata for murals in Northeastern Thailand (cont.)

Element 4	
Name	Description
Definition	The description is a brief summary of the contents of the murals. It should include the main points covered in the murals, as well as the mural's purpose or intent.
Format	Text
Example	The murals of Wat Chai Si were painted on both the inner and outer walls of the ordination hall. In the composition there are some Thai Noi characters written to describe the scene and the placement of the pictures. There are no fixed patterns or sequences. Powder paint was used for cool monochromatic colors, mainly indigo and white.
Element 5	
Name	Inscription
Definition	Marks, texts, or letters that appear in the works, such as signatures, biographies, dedications, etc.
Format	Text
Example	5.1 Author = Thong Thipcha (artist) 5.2 Position = All around the ordination hall. 5.3 Text (text) = <i>Sinsai</i>
Element 6	
Name	Location
Definition	The location of the work or where the work is stored.
Format	Text
Note	In the case of listing information that is WORK means the location of the murals. In the case of posting IMAGE, it means the place where the image file is stored.
Example	Wat Chai Si Sawathi Village, Village No. 8, Sawathi sub-district, Mueang Khon Kaen district, Khon Kaen province
Element 7	
Name	Rights
Definition	Information about copyright status and rights holders for works, collections, and images.
Format	Text
Example	Fine Arts Department
Element 8	
Name	Style Period
Definition	The name of the production style, the historical era, the school of the production, or any other name that can be used to represent the nature of the work.
Format	Text
Example	Isan folk arts.

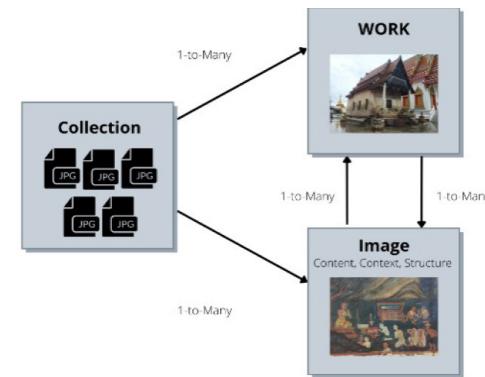
Table 4 Description of data elements in metadata for murals in Northeastern Thailand (cont.)

Element 9	
Name	Subject
Definition	Words or phrases that represent the key content of murals, which can involve the concept, object, event, place, person, corporate body, or name in the location of murals.
Format	Text
Example	Murals of Wat Chai Si Wat Chai Si <i>Sang Sinchai</i> , locally known as <i>Sinsai</i>
Element 10	
Name	Technique
Definition	A description of the creation method or production process, the techniques, and methods included in the creation or transformation.
Format	Text
Example	Powder colors and natural colors.
Element 11	
Name	Text ref
Definition	Name or reference Information related to other forms of works such as books, exhibition titles, other database names, etc.
Format	Text
Example	Office of Archeology and the 7th National Museum, Khon Kaen. (2000). Simpin Ban Wihan Local. Winitprint, Udon Thani.
Name	Text ref
Element 12	
Name	Title
Definition	Names or phrases that are assigned to murals.
Format	Text
Note	Most of the murals use the temple's name instead of the subject matter of the mural.
Element 13	
Name	Work type
Definition	Defines the type of WORK, COLLECTION, or IMAGE specified in the log.
Format	Text
Note	It is an element used to separate the types of works.
Element 14	
Name	Conserve
Definition	Mural restoration information.
Format	Text
Note	More than one value can be specified. Increases the number of data records by the number of restorations.
Example	14.1 Name = Division of Archeology 14.2 Date = B.E. 2533 or C.E. 1990 14.3 Description = The Urgent Mural Conservation Project

Table 4 Description of data elements in metadata for murals in Northeastern Thailand (cont.)

Element 15	
Name	Position
Definition	It indicates the building where the mural was found.
Format	Text
Example	Ordination hall
Element 16	
Name	Structure
Definition	An overview of the mural and all the content elements found in the mural are shown.
Format	Text
Note	It is an element used to describe the WORK so that the user knows the subject and focus of all the pictures on the wall.
Example	1.61 Dominant = <i>Sinsai</i> (outer wall)/life of the Buddha (inner wall) 2.61 Subdominant = <i>Vessantara Jataka</i> 16.3 Subordinate = Hell scenes/Lifestyle
Element 17	
Name	Type
Definition	Description of the overall characteristics of the mural
Format	Text
Example	Story picture
Name	Type
Element 18	
Name	Sequencing
Definition	Description of the order of the content of the murals.
Format	Text
Note	More than one text value can be specified because some murals were painted on both the outer and inner walls.
Element 19	
Name	Date/time
Definition	The date is recorded in the system.
Format	Text
Note	Specify the day, month, and year as a number. Use the ISO 8610YYYY, YYYY-MM or YYYY-MM-DD data standard as appropriate.
Example	2020-07-15

All elements of metadata describe the features of the murals, which link to other photos by passing through the elements of the relationship between the data. This metadata work uses the 1:1 principle; one picture will have only one record, while complex images, such as images from the same object, will be connected by the relationship of the elements.

**Figure 1** Features of the metadata data model for murals

Conclusion and Discussion

The research findings present the metadata's unique characteristics related to content, context, and physical structure. The metadata is a collection of data that provides information about other data. Metadata is used to organize, manage, and store data. The metadata can be divided into the following three categories. 1) Data about the content: this includes information about the data source, format, structure, and quality. 2) Data about the context: this includes information about the purpose of the data, the time period, the geographical area, and the data users. 3) Data about the structure: this type of metadata describes the physical structure of the data. It includes information about the data's size, format, and location. The metadata should be accurate, clear, and concise. It should also be updated regularly to ensure that it remains accurate (Baca, 2008).

The research findings confirmed the previous research results, that, in the development of metadata to support user requirements and access to an information resource, each document needs specific metadata depending on its physical structure, content, and user needs (Heery and Patel, 2000; Library of Congress, 2007). Additionally, there is no single metadata schema that can meet every requirement of a digital collection by nature of metadata. Therefore, the metadata schema should be flexible enough to allow for the inclusion of additional

metadata elements (Liu, 2007). Moreover, there are many similar metadata standards, such as CDWA and VRA Core, i.e., the s for Metadata Objects and Visual Resources, which are used to describe the visual resources. In addition, some studies develop metadata for Thai cultural objects, such as metadata for palm leaves, metadata for inscriptions, and the Metadata Schema for Folktales in the Mekong River Basin. The schema includes elements for identifying the title, author, date, source, and subject of a folktale, as well as elements for describing the plot, characters, and setting of the story (Chaichuay, et al., 2017; Kwiecien et al., 2021; Manmart et al., 2012). VRA Core supports the description of the original work of art, architecture, or material culture and its visual surrogates, digital or otherwise. The VRA Core schema has the added advantage of describing the cultural aspects of the object; for example, cultural Context and creator Role are essential elements in the VRA Core schema (Woodley, 2016).

Although the development of the metadata schema for managing knowledge about murals proceeded as an existing VRA Core standard, murals in Thailand have different features and characteristics from other artworks. Therefore, the metadata schema for murals in Thailand was developed based on the VRA Core standard, but with additional elements to support the specific characteristics of these murals. Thai murals were painted on the walls of temple buildings to make merit. The content of murals is related to Buddhism (Buddasarn, 2003), and the mural paintings of Thailand painted on the Buddhist religious buildings are found at the entrance, pillars, windows, etc. (Cate, 1998; Samosorn, 1989). Therefore, to describe the murals, it is necessary to explain the structure and sequence of the murals that are different from the current standards. The metadata needs to define new elements and values to describe the murals. The dominant features of mural metadata schema include 19 elements that present the unique characteristics of murals. It is different from other types of documents and cannot be found in the existing metadata standards. These elements were developed from the VRA Core (Library of Congress, 2007). The development of metadata elements from international standards allows for adjustments

based on other international standards and enables information exchange between them. However, the metadata element of murals needs to be further studied, verified, and simplified as a standard to be used worldwide (Devey and Marie-Claude, 2016; Liu, 2007).

Finally, the applications of this research are as follows: 1) The metadata schema of murals for Northeastern Thailand can be used to create a digital library or collection to manage the murals. This schema includes information about the artist, the date of the mural, the location of the mural, and its subject matter; 2) to expand the scope of mural study throughout Thailand or in countries with similar mural characteristics, such as other countries in the Mekong Sub-region; and 3) to expand the metadata schema by creating a link with an open-access vocabulary list, such as an ontology or a thesaurus, which will support semantic searches and links to other sites, and open data, enabling people to share resources in their libraries and organizations.

Acknowledgement

This research was funded by the Digital Humanities Research Group (DHRG), Khon Kaen University.

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