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DEVELOPING EVALUATION SUB-CRITERIA FOR GEOHERITAGE INTERPRETATION IN LANGKAWI UNESCO GLOBAL GEOPARK (LUGG): A CONTENT ANALYSIS APPROACH

MAZZUEEN MD KHALID[1,2], TANOT UNJAH[1] AND SHARINA ABD HALIM[1]*

[1]*Institute for Environment and Development, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia.* [2]*Studies of Park and Amenity Management, School of Geomatic Science and Natural Resources, College of Built Environment, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.*

**Corresponding author: mazzueen@uitm.edu.my*
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Abstract: In Geotourism management, interpretation is an important instrument for providing visitors with a memorable experience. Managing visitor volumes, behaviours, and impact as well as enhancing visitor experiences are all part of its expanded potential uses. Interpretation services at geoparks are often offered in a face-to-face or non-face-to-face (visual) manner. A specific study was conducted of a geopark's interpretation service that communicates information on the geological, biological, and cultural elements of the park. The study sought to ensure a high-quality interpretation service and its continuous improvement in Langkawi UNESCO Global Geopark (LUGG). This necessitates a consistent framework for regular monitoring and evaluation. Therefore, this study aims to identify the sub-criteria for the development of an evaluation framework for geoheritage interpretation at the LUGG. By conducting a content analysis of available literature on nature-based tourism and field observations, this study aims to highlight management, information, communication systems, and visitor criteria as essential components in developing the interpretation evaluation for the geoheritage along the geopark trail at the LUGG. The outcome of this study will benefit interpretation services providers at geoparks across the country and the region while contributing to the Sustainable Goals for Development 17 (SDG 17).

Keywords: Geoheritage interpretation, geopark trail, interpretation evaluation criteria, geotourism.

Introduction

The Langkawi Island of Malaysia was declared as geopark by the Kedah state government in 2006 and accepted as a member of the Global Geoparks Network (GGN) in 2007. The Langkawi Geopark was the first geopark in Malaysia and Southeast Asia (Komoo, 2010). Langkawi Island is a popular geotourism destination in Malaysia due to its abundant geological resources, terrestrial and marine-based wildlife, and distinctive local culture. The Langkawi Geopark concept was first introduced in 2000 which was in line with the development of the idea of geoparks in Europe (Komoo *et al*., 2010). A geopark is a protected area with internationally significant geology that pursues sustainable development through tourism, conservation, education, and research, as well as other relevant sciences (Du & Girault, 2018). A European geopark was described in 2005 as a location with a distinct geological heritage and long-term territorial development. The goal of a European geopark is to increase residents' employment options (United Nations Educational, Scientific and Cultural Organisation, 2016). Hence, geoparks are protected areas that being used to manage geological heritage resources sustainably. The geological, biological, and cultural aspects of the site are all protected in this area. The main goals of the region's formation are conservation, education, and promotion of local areas through geotourism.

Geotourism is one of the tourism industry's divisions that covers geological or geosite visits. The geotourism sector was established in the early 2000s and has continued to expand (Ruban, 2015). Over the past 10 years, both have expanded quickly. Geotourism has developed in part as a response to the need to reduce the detrimental effects of mass tourism on tourist areas that are geologically and geographically well situated while acting as a catalyst for sustainable rural development (Ólafsdóttir & Dowling, 2014). According to Newsome and Dowling (2010a), geotourism encourages tourism to geosites by preserving geodiversity and increasing knowledge of Earth sciences through appreciation and education. These are accomplished through visits to geologically significant areas, use of geological routes and standpoints, guided tours, geological activities, and support for geosite visitor centres. Interpretation is one of the best ways to ensure that the geoparks' message is conveyed to visitors in the most precise and easily understood ways. Interpretation supports geotourism, preservation of geodiversity, and understanding of Earth sciences via appreciation and learning.

However, often the scientific importance of geosites is overlooked and not included in all elements of the attraction. Even if it is, it is presented in a way that the public finds it difficult to understand (Tongkul, 2010). Despite their enthusiasm, tourists can only understand what they physically see. Tourists' perceptions may not match what geologists are trying to convey. According to Frey *et al*. (2006), the primary goal of geotourism is to disseminate and communicate geoscientific knowledge and philosophy to the general public. This demonstrates the significance of interpretation in conveying geoscientific knowledge to tourists so that it can be easily comprehended. The interpretation of geoattraction occurs through an approach comprising geology and tourism (Dowling & Newsome, 2018a). Interpretation is a persuasive communication technique that transmits technical information to the recipient in a way that is easy to comprehend, relevant, and meaningful (Lin & Mariapan, 2015). Interpretation is a service offered in almost all focal areas, including national parks, urban parks, historical areas, zoos, museums (both indoor and outdoor) and other tourist attractions. Visitors have a platform to appreciate the beauty and distinctiveness of nature through the interpretation facilities in natural areas.

Evaluations of interpretation must be carried out by the agencies involved to ensure that geosites for heritage interpretation programmes and facilities perform well. To support ongoing service improvement, organisations in the tourism industry are interested in performing an internal review of their interpretation services. The success of heritage interpretation in geoparks depends on continuous and continuing evaluation. The educational goals of geoparks are identified in this study's heritage interpretation for a geosite and these important evaluation indicators result in a thorough standard for heritage interpretation at a geopark. Therefore, to develop an interpretation evaluation framework, the study highlighted the significance of management, information, and communication systems, as well as visitor criteria in developing a tool for the evaluation of interpretation services for the geopark trail at the Langkawi UNESCO Global Geopark via a content analysis study of literature on nature-based tourism and field observations.

Literature Review

Concept of Geoheritage Interpretation

Geoheritage interpretation is crucial in geoparks as it acts as a means of communication that improves the tourism experience by making intricate scientific information understandable and significant to a wide range of people. Interpretation, as defined by Tilden (1976a) is an educational endeavour that establishes a connection between individuals and their surroundings by including them in human encounters, authentic artefacts, and visual media. This method is not restricted to heritage or environmental contexts; instead, it is a flexible tool that has been extensively used in

several tourism regions to highlight ecological connections and promote sustainable visitor behaviour (Kuo, 2002). Geoparks aim to provide exceptional and significant geotourism experiences by effectively communicating the scientific and cultural significance of geoheritage locations. This interpretation plays a crucial role in influencing how visitors respond to both push factors (such as novelty and education) and pull factors (such as experience and site design), ultimately affecting their overall experience and supporting sustainable management practices (Xu & Wu, 2022; Sadry *et al*., 2022; Pijet-Migoń & Migoń, 2022). This study emphasises the role of geoheritage interpretation as a diode, which serves as a channel connecting geodiversity, landscape, and visitors. Ultimately, this facilitates a greater comprehension of the interconnections within geoparks.

Types of Interpretation

To achieve interpretation objectives, there are two basic approaches or methods of interpretation that can be implemented which are face-to-face and non-face-to-face interpretation. Table 1 shows the two types of interpretations used to convey messages to visitors. Face-to-face interpretation also known as personal interpretation is on site interactive interpretation provided for the visitor by interpreters, tour guides, organised activities, etc. (Cheng *et al*., 2017). Non-face-to-face refers to interpretive services provided through interpretive media such as signage, brochures, exhibits, and self-guided tours (Cheng *et al*., 2017).

Figure 1 is an example of face-to-face interpretation. The interpreter communicates with the visitors in several ways such as throwing some questions, imitating animal

Table 1: Types of Interpretation

Types of Interpretation	Medium	Function
Face-to-face Interpretation	In House Interpreter	People are responsible as storytellers, speakers to visitors. Often from among staff themselves, volunteers, or practical students.
	Ranger	One of Wildlife Department (Jabatan Perlindungan Hidupan Liar dan Taman Negara - PERHILITAN) and Forestry Department (Jabatan Perhutanan Semenanjung Malaysia - PERHUTANAN) duties is as an interpreter or guide.
	Tour Guide	Divided into two (2) categories city guide (blue card) and nature (green card) with licenses.
Non-face-to-face interpretation	Brochure	This folded information document is a must in every area
	Panel	Placed along the trail with identified checkpoint
	Audio-visual	This electronic media possesses both sound and visual usually placed in several areas and checkpoints that are suitable for interpretation storyline.
	Diorama	This three-dimensional figure, either in miniature or on a large scale is always used in indoor interpretation. Sometimes combination with the audio story
	Artifacts	This artifact material presented real material depending on the interpretation approach
	Replica	This copy material is used to show the audience, how it looks like
	Interpretation Center	Exhibition compilation of artifacts, replicas, audio-visual etc. that are suitable and related to the place

Figure 1: Types of face-to-face interpretation

styles, and talking in various intonations. Meanwhile, Figure 2 illustrates non-face-to-face interpretations which are either a panel, a brochure, an artifact, or an audio-visual presentation. If there are materials for artifacts, real artifacts will be put up. Or else, the management will produce a replica to show what it looks like. With regard to the audio-visual, the video or audio will be turned on or automatically turned on by a particular technology to present the story to the visitors without the need for the interpreter or tour guide to be present. This non-face-to-face interpretation can be placed along the trail, museum, visitor centre, viewpoint, etc. In the early methods of interpretation, most of the approaches were either face-to-face or non-face-to-face and geared more toward giving information in non-interactive ways.

The first face-to-face interpretation features is more talks or lectures, whereas the non-face-to-face method started with a guidebook that became a reference for the visitors who come to Yosemite National Park. However, after the introduction of Tilden's principles in 1957, the interpretation method became more creative, interactive, and interesting. Later, these interpretation services provided at the tourism areas became crucial tools for visitor management (S. A. Ham, 1992). Later, the term "environmental interpretation" popular for interpretation with a clear focus on the environment and conservation (Kohl, 2005). From the current trend of interpretation, in every public park managed by the government, the park ranger will lead a face-to-face interpretation. Moreover, for private or commercial interpretations, there are interpreters or the visitor can hire a tour guide as an interpreter during their visit to a particular place. Today, however, technology is widely used for non-face-to-face interpretations, including Visual and Augmented Reality (V.R. and A.R.) and quick response (QR) codes that are linked to the panel interpretation, so that visitors can receive information and make their own judgements.

In Malaysia, interpretation services have been provided virtually and managed by the government or private agencies in tourism or at focused areas such as parks. Parks and recreation areas in Malaysia are readily accessible to the public; thus, suitable places for learning about the environment even for very young students (Azlin *et al*., 2006). Along with this accessible learning environment, interpretation services are among the most basic facilities provided for in the National Ecotourism Plan (Ministry of Tourism and Culture Malaysia, 2016) which emphasised that interpretation is suitable for the soft ecotourism spectrum because most visitors compare it to adventures and the hard ecotourism spectrum. Due to the new trends in global interpretation and face-to-face interpretation services, the Malaysian government has arranged for rangers from the Department of Wildlife and National Parks Peninsular Malaysia (PERHILITAN), Forestry Department of Peninsular Malaysia (PERHUTANAN), and state park agencies. The respective officers will guide visitors and give

Figure 2: Non-face-to-face interpretation

nature talks to those who come to the forest reserve or any natural area under the agencies' authority. Besides that, every recreational forest area will be provided with an educational centre that will offer interpretation programmes, conducted by the rangers. As is happening globally, visitors can also use a tour guide to lead the interpretation activities without any need to engage the park rangers.

Principle, Theory, and Model in Interpretation

In developing an evaluation framework for heritage interpretation in Geopark trails, the important key points involving the implementation and assessment of the interpretation have been identified. Interpretation evaluations have been conducting using several methods and approaches. For example, questionnaires, interviews, and observations on the various themes of tourism such as the zoos, nature areas, museums, commercial parks, and visitor centres. There are many possible reasons for the existing evaluations. They vary for each situation but include; (a) assessing performance of individuals; (b) providing accountability; (c) assessing economic efficiency; (d) determining reasons why a communication programme is effective or not effective; and (e) measuring impacts or outcomes (S. Ham & Weiler, 2006). For these reasons, it is important to carry out an evaluation not only for visitor satisfaction but also for the benefit of the organisation that manages the interpretation. This is especially since these organisations have put in a lot of effort and invested a lot of money to ensure that visitors have the best possible experiences.

For this study, the implementation theory of interpretation has been identified to be used as the basis of the evaluation framework. The implementation of interpretation is based on certain principles, theories, and models that have been found in earlier studies. Referring to Table 2 on theory and model for interpretation, Freeman Tilden is a pioneer in this field. He is responsible for the basic principles called the Tilden Principles for interpretation. To ensure that the message being conveyed can be understood, this principle must be applied to every piece of information that is provided to visitors. However, this principle only emphasises the message that is intended to be conveyed.

Table 2: Theory, principle, and model of interpretation implementation in a tourism setting

Interpretation Theory/Model	Initiate	Year	Implementation Criteria
Tilden Principles	Freeman Tilden	1957	1- Provoke, 2-Relate, 3-Art, 4-Revelaation, 5-Address as a whole
Elaboration Likelihood Model	Richard E.Petty & John Capioppo	1986	1-Message, 2-Information, 3-Attitude, 4-Audience Motivation,
Actioned Reasoned Theory	Martin Fishbein and Icek Azjen	1980	1-Message, 2- Motivation, 3-Audience Motivation
Mindfulness	Ellen Langer	1981	1 – Place, 2-Cognitive, 3-Communication, 4-Visitor
TORE Model	Sam H Ham	2008	1-Theme 2-Organise, 3-Relevant, 4-Enjoyable

Following that, the Elaboration Likelihood model was identified as a method for implementing interpretation. According to Petty and Cacioppo (1986) theory, the following criteria must be present in performing interpretation: Message, information, attitude and audience motivation. The Elaboration Likelihood model explains how people's attitudes can be persuaded to change. People are more likely to be persuaded through the central route when they are invested in a topic and have the time and energy to think about it (Petty *et al*., 1992). This Elaboration Likelihood model refers to the communication process in the interpretation of recreation and ecotourism areas.

Martin Fishbein and Icek Azjen's Actioned Reasoned theory expands upon the Planned Behaviour theory. It focuses on a person's voluntary behaviour by determining their basic driving force (S. H. Ham, 2008). The theory looks at the visitor's experience while using the interpretation services provided. The application of interpretation should take a broad view while not ignoring the principles of delivering the information or message in an easy-to-understand manner.

Next, the Mindfulness theory emphasises that interpretation needs to include larger aspects. Previous interpretation studies have shown how Mindfulness theory affects the effectiveness of interpretation. As exemplified by the findings of studies conducted in Kruger National Park and Soweto, the use of Mindfulness theory provides a set of guidelines for the design and management of experiential settings, so that they include the types of features that may encourage attentive visitors (Moscardo, 2017). This study demonstrates that in order to give visitors the best experience possible, the implementation of interpretation must include a design setting and management component. Mindfulness theory was developed by Ellen Langer to describe the effective and behavioural responses of individuals in different social situations (Moscardo, 2009).

Sam H. Ham is one of the figures who has made significant contributions to the field of interpretation and he is the creator of the TORE model: Thematic interpretation. The TORE model states that interpretation has four essential qualities: Theme, organisation, relevance, and enjoyment. An essential principle of thematic interpretation is that a place only matters to people when they leave with a variety of intangible values such as memories, thoughts, understandings, and new perspectives. Due to increased customer satisfaction, word-of-mouth advertising, and repeat visitors, the average amount spent by visitors increased (Amin *et al*., 2014). Using the TORE model of interpretation is the best communication approach to help improve visitor experiences, influence attitudes, promote appreciation, and strengthen the protection of important rare or fragile resources such as geosites in geoparks. The main interpretation evaluation criteria is classified based on five basic principles, theories, and models in the implementation of

interpretation. The principles, theories, and interpretation models serve as the foundation for further developing the primary evaluation criteria for geosite heritage interpretation.

Based on five basic principles, theories, and models, the development of the main evaluation criteria is coded according to the theme of the significance of interpretation implementation. Referring to all models, theories, and principles, Mindfulness theory is seen to include comprehensive aspects to ensure the effectiveness of interpretation. This is followed by the Elaboration Likelihood model and Actioned Reasoned theory. These three theories focus on how to manage the setting of the interpretation, the content of the interpretation to be delivered, the communication approach, and the management of visitors or audiences. The determination of interpretation evaluation criteria is strengthened by Moscardo who presented a framework that states that the effectiveness of interpretation implementation includes these four categories: Conceptualising them as tourist factors, place factors, management factors, and communication system factors (Noor *et al*., 2015). While the Tilden Principles and the TORE model focuses on delivering interpretation. Therefore, based on the theories, models, and principles, the primary evaluation criteria consists of management, information, communication systems, and visitors as theme codes for content analysis.

Interpretation Evaluation Outcome

Various studies on interpretation have been done to identify whether the interpretation services provided can achieve the interpretation objectives. Based on Table 3, a review of articles

Table 3: Finding of interpretation evaluation outcome from previous studies

Author	Year	Finding
Smith *et al.*	2019	Four categories of an outcome: (1) Taken in response to the experiences (2) general knowledge; (3) the experience's ecological and environmental content; and (4) a statement of attitude based on ecology that may have been influenced by the experience.
Ballantyne *et al.*	2018	Observing and interacting with animals in both captive and non-captive wildlife tourism settings has been shown to improve visitors' environmental knowledge and attitudes, as well as their intentions to engage in sustainable environmental behaviour.
Hvenegaard	2017	Interpretive outcomes related toward knowledge, attitudes and behaviour.
Marschall	2017	(1) Ensure visitor satisfaction, (2) improve visitor understanding, (3) attitude change and (4) behavioural change.
Cheng *et al.*	2017	Improving the quality of visitors' experiences, ensuring their safety, fostering knowledge among visitors, encouraging favourable attitudes toward the natural and cultural heritage resources, and encouraging environmentally friendly behaviours among visitors.
Tan & Law	2015	Has examined the degree and nature of visitor interaction with various interpretive media in relation to interpretive outcomes and visitor behavioural indicators.
Stern & Robert	2014	The assessment of the relative efficacy of guided and non-guided interpretation used the four main goals of interpretation, visitor satisfaction, knowledge gain, attitude change, and modification of behaviour intent.
Stern & Powel	2013	The interpretation outcomes of audience characteristics of interpretive programmes, as well as resource quality, were investigated. The findings revealed that the four factors listed above have a significant impact on visitors.
Weiler & Ham	2010	Three broad domains of interest have been found to be potentially impacted by interpretation; tourist cognition (what they feel), and tourist conative tendencies (what they do)

based on several studies on interpretation evaluation from 2010 to 2019 noted that visitor satisfaction, knowledge gain, behavioural modification, and attitude change were identified as the interpretation effectiveness outcomes.

The results of interpretation evaluations are critical in assessing the efficacy of interpretation services at cultural sites. Examining numerous studies allowed this research paper to uncover common themes and distinctive contributions to the area.

Evaluation Criteria in Geopark

Although there has been notable advancement in creating evaluation standards for assessing the importance of geoheritage, there is still a significant lack in generating criteria especially designed for its interpretation. The necessity to identify, construct, and implement a well-defined assessment instrument that is in line with specific management and conservation goals has motivated the development of evaluation systems tailored to individual local conditions. By incorporating these evaluation standards into the administration of geopark resources, stakeholders seek to improve the educational and supportive functions that geoheritage may provide as well as to promote social and economic progress by integrating it in geotourism activities.

The main objective of these evaluations is to determine the resources that have the greatest impact on these goals, assign them weighted importance, and prioritise areas that require immediate attention in order to preserve their value (Cengiz *et al*., 2021; Crofts *et al*., 2021; Pijet-Migoń & Migoń, 2022; Xu & Wu, 2022). The evaluation frameworks established by the European Geoparks Network (EGN) and the UNESCO Global Geoparks Network (UGGN) has received widespread agreement, despite the existence of a few more qualitative criteria. Several nations have included these rules as official standards for assessing international geoparks, resulting in a methodical, uniform, and proportional review procedure. The requirements are classified into four main domains: Earth heritage and its associated scientific investigation, management, protection, and education (Rodrigues *et al*., 2021).

The UGGN's evaluation criteria places significant importance on the distinctiveness and excellence of geological characteristics in many geographical contexts, including global, national, regional, and local scales. Formosa Island that situated on the western edge of the North China Plate displays evidence of important geological events, including folding and faulting during the orogeny. It also features a range of geotopes that depict the relevant evolutionary history (Chiu *et al*., 2021). In addition, the criteria also considers the appeal and potential of certain geographical features to be utilised as tourist assets.

Although these qualitative appraisal levels are recommended in order of diminishing significance, they do not include the essential quantitative measures required for accurate evaluations. The lack of clear and precise definitions for terms also leads to subjective disparities in the automation of these duties. This poses challenges in meeting the demands of today's stakeholders. Consequently, only a small number of research has created methods and criteria that adhere to these stringent measuring standards. To address this deficiency, certain regions such as Hong Kong, Langkawi, and Cat Ba have started employing other criteria to assess the significance of geosites. This is done with the aim of enhancing the effectiveness of geoheritage projects.

The continuous development of geoheritage evaluation highlights the necessity for stronger and uniform criteria, both in assessing the importance of geological features and in improving their interpretation. Coordinating evaluation systems with interpretive approaches can significantly enhance the capacity of these sites to enhance educational objectives, engage visitors, and achieve a sustainable expansion within the geoparks.

Geopark Trail in Geotourism

Over the centuries, trails and routes have been essential for travel and tourism, helping to lay the foundation for both historical and contemporary mobility patterns. Although they have been acknowledged as components of human landscapes, their contributions to tourism and recreation have gone unrecognised (Timothy *et al*., 2015). Trails are the main components of a park to connect from one area to another within the park. The construction of the trails requires planning to ensure that the parks' facilities function properly and support activities for each location that is connected. The geotrail concept creates recreational facilities that provide visitors with an experience related to the geological phenomenon of high value geosite areas. Geotrails have demonstrated the ability to increase geotourism potential (Norrish *et al*., 2014) and support geotourism. The interpretation provided by visitors to the geosites is the most important aspect of a geotourism destination (Newsome *et al*., 2012). As a result, the use of a geotrail needs to be decided upon with the aid of interpretive components.

Natural area tourism with a focus on geology and landscape is known as geotourism. Through appreciation and education, it encourages travel to geosites, the preservation of geodiversity, and an understanding of Earth sciences. These are accomplished by going to geological features on your own using geotrails and viewpoints, going on guided tours, participating in geoactivities, and visiting visitor centres at geosites (Newsome & Dowling, 2010b). According to Hose (2012), to promote conservation through the creation of appreciation, learning, and research for current and future generations, geotourism entails the provision of interpretation and service facilities for geosites and geomorphosis as well as topography and in situ and ex situ artifacts.

Geoheritage

Geological features, landscapes, and phenomena that are noteworthy for their scientific, educational, cultural, artistic, or recreational significance are referred as geoheritage. These characteristics are conserved because they are crucial to comprehend Earth's history, geological processes, and planetary evolution. They are frequently seen as parts of Earth's natural legacy. According to Brocx and Semeniuk (2007), the term geoheritage is expanded and modified from Semeniuk (1997) and Semeniuk and Semeniuk (2001) explained as: Globally, nationally, state-wide, to local features of geology such as its igneous, metamorphic, sedimentary, stratigraphic, structural, geochemical, mineralogic, palaeontologic, geomorphic, pedologic, and hydrologic attributes, at all scales that are intrinsically important sites or culturally important sites that offer information or insights into the formation or evolution of the Earth, into the history of science, or can be used for research, teaching, or reference.

In the context of geoheritage, a geosite is a particular place or region that has been chosen and designated due to its educational and geological significance. The selection of geosites is usually based on the geological features, landscapes, or events that offer significant insights into the evolution, history, and processes of Earth. A geosite is a place that has the value of geological heritage and natural resources based on the intrinsic values of geological and geomorphological features. Geomorphological sites have been classified according to the use of their scientific, scenic, cultural, and economic values (Coratza & Hobléa, 2018). Geosites, geological, or geomorphological sites with a recognised value as determined by an audit, assessment, and selection process faces a variety of threats. Preserving geosites for scientific, educational, geotourism, and other purposes is a crucial aspect of conserving geoheritage (Prosser *et al*., 2018). Geosites that have been categorised are typically found within geoparks which are designated places for geotourism. These geosites are easily accessible to visitors for the purpose of educating and raising public awareness. The Langkawi UNESCO Global Geopark empowers local communities to make decisions and support sustainable

tourism and preserve geoheritage. This is achieved through an inclusive and participatory process, supported by the local government and relevant stakeholders and facilitated by an enabling governance framework (Jing *et al*., 2022). Developing a comprehensive evaluation system is crucial to ensuring the effectiveness of heritage interpretation in this collaborative setting. This approach will be used to assess the efficacy of interpretive activities in advancing sustainable tourism and conserving geoheritage resources.

Methodology

The aim of this study is to provide evaluation sub-criteria for the interpretation of geoheritage in the Langkawi UNESCO Global Geopark (LUGG). The research methodology employed in this study primarily revolves around content analysis which is a systematic and reproducible research technique for deriving precise conclusions from textual material within a specific context (Krippendorff, 2013; Neuendorf, 2017). The selection of content analysis was based on its effectiveness in analysing written materials, particularly in the context of understanding geoheritage in various geopark centres.

Literature Review and Thematic Analysis

To establish a robust foundation for the evaluation criteria, a comprehensive literature review was conducted, systematically examining scholarly journal articles. This review provided the basis for creating the precise evaluation sub-criteria and contributed to the thematic analysis of the guidelines, standards, and manuals used to interpret geoheritage material, particularly within LUGG. The purpose of the thematic analysis was to identify the prevailing themes or concepts consistently present in the guidelines and manuals used in the Kilim Karst Geoforest Park, Machinchang Cambrian Geoforest Park, and Dayang Bunting Marble Geoforest Park. The topics were classified based on four main criteria which were substantiated by the literature review. The criteria was later employed to assess the interpretation strategies of Langkawi UNESCO Global Geopark which can be categorised into two primary components: Direct interpretation (such as guided tours and educational programs) and indirect interpretation (including informational signage, brochures, and digital content).

Systematic Content Analysis

The content analysis method was employed to evaluate the interpretative texts shown on panels in geopark centres around the world with a particular focus on the criteria for interpreting geoheritage. The study seeks to comprehensively examine the communication and implementation of geoheritage materials by examining textual content, comparing information availability among various centres, and evaluating the resulting outcomes. This approach also involved conducting cross-examinations of different locations to determine the accessibility and effectiveness of interpretative materials and utilising checklists and result analysis to ensure a thorough comparison.

The analytical results emphasise the critical significance of the recommended sub-criteria in enhancing the understanding and acknowledgement of Langkawi's geoheritage. The content analysis has the potential to generate a specific interpretation guideline, which will significantly advance the research by laying the groundwork for future investigations in the geopark context. This survey also included insights from expert respondents who were actively involved in the establishment and management of LUGG, either directly or indirectly. Their assistance was vital in understanding the current interpretation processes and identifying chances for improvement.

In summary, the systematic use of content analysis in this study not only facilitated the discovery and classification of significant aspects but also contributed to the development of a comprehensive framework for reading LUGG that was specifically tailored for this objective. This methodology ensures that the

narratives and communications transmitted through various media platforms such as social media, printed materials, and websites have a significant impact and adhere to rigorous evaluation criteria that determine the appeal, timeliness, and essential elements of geoheritage interpretation.

Results and Discussion

This section delves into a thorough analysis conducted to establish specific evaluation sub-criteria for interpreting geoheritage inside the Langkawi UNESCO Global Geopark (LUGG). The content study involved a systematic examination of various theories, models, norms, and standards that are relevant to comprehend geoheritage. The primary objective of this study was to create and develop specific criteria that may be used to evaluate the effectiveness of interpretive methods in enhancing visitors' understanding and appreciation of geoheritage sites.

Theoretical Foundation and Content Analysis

This study is founded on the established principles of heritage interpretation, which emphasise the significance of efficiently and meaningfully transmitting cultural and natural assets to different audiences. Tilden (1976b), Moscardo (1996), and Md Noor *et al*. (2015) highlighted that the crucial role of identifying significant themes are pertinent to the cultural and ecological aspects of heritage sites to achieve successful implementation of interpretation frameworks. The objective of the content analysis in this study was to identify recurring themes and patterns in the existing guidelines and standards. The purpose of this analysis was to guarantee that the sub-criteria generated are theoretically rigorous and practically applicable.

Content analysis is a widely applicable methodological approach used in the field of interpreting geoheritage. Content analysis allows researchers to systematically categorise material, making it possible to reduce complex and varied ideas into manageable and useful sub-criteria (Krippendorff, 2013). The research effectively identified essential variables from multiple sources, including the UNESCO Global Geopark Guidelines (UNESCO, 2020) and the ASEAN Community-based Tourism Standard. These elements are crucial to the progress of interpretive services at geoparks.

Development of Sub-criteria

The content analysis identified four key criteria that are crucial for the effective implementation of geoheritage interpretation: Interpretation management, interpretation information, communication systems, and visitor management. Each criterion was accompanied by several sub-criteria that capture the intricate demands of both face-to-face and non-face-to-face interpretive techniques.

(1) Interpretation management: This criterion includes a total of 25 sub-criteria for in-person interpretation and 14 sub-criteria for interpretation that is not done in person. Effective management of geoheritage interpretation is essential for organising interpretative events, providing proper training for staff, and actively involving the local community. The UNESCO Global Geopark guidelines prioritise the incorporation of local expertise and the ongoing training of interpreters to provide exceptional interpretative services (UNESCO, 2010). The specified sub-criteria ensures that these management procedures are in accordance with both local requirements and international standards, which will improve the overall quality of interpretation at LUGG.

(2) Interpretation information: A content analysis revealed the presence of 8 sub-criteria for face-to-face interpretation and 19 sub-criteria for non-face-to-face interpretation related to Interpretation Information. The efficacy of geoheritage interpretation relies on the lucidity, precision, and pertinence of the information communicated to visitors. Based on the "Elaboration Likelihood" model and the

principle of "Reasoned Action", this sub-criterion highlights the need of conveying geological features, processes, and timescales in a manner that is both scientifically precise and easily understandable even by non-expert audiences (Fattahi & Khoshraftar, 2012). The comprehensive content analysis verified the indispensability of these components, especially in remote interpretation scenarios, where the lack of a facilitator requires content that is captivating and easy to understand.

(3) Communication systems: There are a total of 25 sub-criteria for face-to-face interpretation and 23 sub-criteria for non-face-to-face interpretation for Communication Systems. Efficient communication is crucial for the success of any interpretative endeavour. The specified sub-criteria pertain to the diverse approaches and methodologies employed for disseminating interpretative content, including signage, pamphlets, and digital media. The principles delineated by Roberts *et al*. (2014) were crucial in establishing these sub-criteria, which guarantee that communication strategies are not only informative but also captivating and inclusive, appealing to a broad visitor base. The content analysis highlighted the significance of these strategies in improving visitor engagement and happiness, especially in situations where direct interaction with interpreters is not possible.

(4) Visitor management: The visitor management criterion consists of 18 sub-criteria for in-person interpretation and 17 sub-criteria for remote interpretation. This criterion centres on the results of interpretive activities, particularly their impact on visitors' acquisition of knowledge, emotional responses, and actions. As stated by J. Veverka (2011), good interpretation should surpass the act of just providing information. It should stimulate contemplation, which results in significant alterations in visitors' attitudes and behaviours. The sub-criteria defined within this category is intended to assess the degree to which interpretive activities accomplish these objectives; therefore, enhancing the overall effectiveness of the geopark's educational and conservational objectives.

Table 3 shows the results of the identification of sub-criteria following a series of content analyses that was conducted by listing and group according to the theme of the main criteria that had been identified.

According to Table 3, there are 35 sub-criteria for face-to-face geoheritage interpretation management followed by the geoheritage interpretation information with 23 sub-criteria. The geoheritage interpretation communication system criteria is then broken down into 42 sub-criteria. While the criteria for geosite heritage interpretation visitors contain up to 26 sub-criteria.

In table 4, the main evaluation criteria for non-face-to-face geoheritage interpretation are listed by theme with 21 sub-criteria for geoheritage interpretation management. The geoheritage interpretation information criteria include up to 21 sub-criteria. There are a total of 22 sub-criteria for the geoheritage interpretation communication system. Last but not least, there are up to 19 sub-criteria for the geoheritage interpretation visitor. There are a total of 207 sub-criteria for the four main criteria for evaluating geoheritage interpretation face-to-face and non-face-to-face. For the four main criteria of face-to-face evaluation of geoheritage interpretation, there are a total of 124 sub-criteria. While there are a total of 83 sub-criteria for evaluating non-face-to-face geoheritage interpretation.

Filtering and Integration of Sub-criteria

In both face-to-face and non-face-to-face interpretation categories, 207 sub-criteria were found as a result of the first content analysis. Nevertheless, acknowledging the necessity for a more targeted and pragmatic assessment

Table 3: The listing of sub-criteria refers to the relevant manual, guidelines and standard to be adapted to the main criteria of face-to-face heritage interpretation evaluation of the geosite

Guidelines/ Standard \ Main Evaluation Criteria	Geoheritage Interpretation Management	Geoheritage Interpretation Information	Geoheritage Interpretation Communication System	Geoheritage Interpretation Visitor Management
Handbook for Evaluation of Interpretive Services in California State Parks (Mcdonald, 2009)	4 sub-criteria	8 sub-criteria	15 sub-criteria	4 sub-criteria
Interpretation Evaluation Kit (Methods and Tools for Evaluating the Effectiveness of Face-to-face Interpreting Programs)(S. H. Ham & Weiler, 2005)	0 sub-criteria	4 sub-criteria	7 sub-criteria	14 sub-criteria
UNESCO Global Geopark Guidelines (Interpretation and Environmental Education)	15 sub-criteria	8 sub-criteria	12 sub-criteria	0 sub-criteria
Guidelines for Interpretation, Education and Guided Training Ecotourism Guidelines for Malaysia Malaysian Ecotourism Planning Plan	9 sub-criteria	3 sub-criteria	6 sub-criteria	5 sub-criteria
Quality Travel and Guide Service Standards ASEAN Community Based Tourism Standard	7 sub-criteria	0 sub-criteria	2 sub-criteria	3 sub-criteria

Table 4: The listing of sub-criteria refers to the relevant guidelines and standard to be adapted to the main criteria of non-face-to-face heritage interpretation evaluation of the geosite

Guidelines/ Standard \ Main Evaluation Criteria	Geoheritage Interpretation Management	Geoheritage Interpretation Information	Geoheritage Interpretation Communication System	Geoheritage Interpretation Visitor Management
Interpretive Graphics: Interpretation Standards (J. A. Veverka, n.d.)	12 sub-criteria	10 sub-criteria	11 sub-criteria	5 sub-criteria
Geological Conservation: A Good Guide to Good Practice (Posser *et al*., 2006)	4 sub-criteria	5 sub-criteria	7 sub-criteria	2 sub-criteria
Interpretation Handbook and Standard Distilling the Essence (Colquhoun & New Zealand Department of Conservation, 2005)	5 sub-criteria	6 sub-criteria	4 sub-criteria	12 sub-criteria

framework, a meticulous procedure of filtering, elimination of duplicates, and consolidation was carried out. The approach resulted in a decrease in the number of sub-criteria to 76 for face-to-face interpretation and 73 for non-face-to-face interpretation, respectively (Table 5). This revision was crucial in order to guarantee that the sub-criteria are not only thorough but also feasible, enabling their actual implementation in the field.

The refined sub-criteria were subsequently evaluated by a panel of experts in the field of heritage interpretation. The feedback from these experts was invaluable in validating the relevance and applicability of the sub-criteria to the context of LUGG. Their insights helped to ensure that the final set of sub-criteria is robust, context specific, and capable of supporting the continuous improvement of interpretive services at LUGG and other geoparks.

The implications for Geoheritage Interpretation

The creation of these sub-criteria is a noteworthy addition to the field of interpreting geoheritage. Effective communication of the scientific, cultural, and aesthetic importance of geological features to the public relies heavily on geoheritage interpretation. Utilising a structured evaluation framework offers a dependable method for assessing the effectiveness of interpretation services (Dowling & Newsome, 2018b). This framework not only gives a methodical methodology for analysing present practices but also provides practical suggestions for enhancement. Geopark managers can use these sub-criteria to detect deficiencies in current services and distribute resources more efficiently. This can be done via staff training, introducing new interpretive themes, or updating exhibits (Dowling & Newsome, 2018b). This focused strategy guarantees that interpretative services adapt to fulfil the ever-changing requirements of tourists, so improving their entire experience.

Moreover, the utilisation of this evaluation approach goes beyond only visitor involvement; it has significant ramifications for the wider management and conservation objectives of geoparks. Interpretation, when done well, plays a vital role in teaching the public about the significance of geoconservation and cultivating a sense of stewardship (Reynard & Brilha, 2018). The framework indirectly promotes the sustainable management of geopark resources by enhancing the quality of interpretation. This aligns with the objectives of education, conservation, and sustainable tourism. Interpretive services can foster a more profound comprehension and admiration among visitors by highlighting topics like biodiversity, climate change, and the cultural importance of geological formations. This is crucial for the enduring conservation of these sites (Hose, 2012b).

Furthermore, the continuous improvement of interpretive services led by this framework guarantees that the geopark remains an important resource not just for local people but also for world heritage. The framework facilitates the maintenance of equilibrium between conservation endeavours and the advancement of tourism,

Table 5: The number of sub-criteria for face-to-face and non-face-to-face evaluation of geoheritage interpretation after filtering, duplication, and integration

	Face-to-Face Interpretation	Non-Face-to-Face Interpretation
Geoheritage Interpretation Management	25 sub-criteria	14 sub-criteria
Geoheritage Interpretation Information	8 sub-criteria	19 sub-criteria
Geoheritage Interpretation Communication System	25 sub-criteria	23 sub-criteria
Geoheritage Interpretation Visitor	18 sub-criteria	17 sub-criteria
TOTAL	**76 sub-criteria**	**73 sub-criteria**

which presents a significant issue in the administration of geoparks. By doing this, it guarantees the long-term viability of the geopark in terms of its impact on the environment and its economic stability, while also strengthening its position in the preservation of global heritage. The continual enhancement of Langkawi UNESCO Global Geopark (LUGG) will have a good impact on tourists, personnel, and the geopark as a whole. This will ultimately guarantee that LUGG remains a vital contributor to worldwide geoheritage conservation efforts.

Conclusions

The establishment of geoparks such as the Langkawi UNESCO Global Geopark (LUGG) relies heavily on the effective communication of heritage values through geoheritage interpretation. Interpretive services which encompass both in-person and remote techniques play a crucial role in promoting public understanding, furthering geoconservation initiatives, and enhancing the visitor experience. Given the vital importance of interpretation in various fields, it is essential to regularly assess and appraise these services to ensure their quality and efficacy.

The objective of this project was to develop a comprehensive evaluation technique specifically tailored for LUGG in order to address the ongoing need for continual improvement in historical interpretation inside geoparks. This study conducted a comprehensive analysis of interpretative signposts, brochures, and qualitative in-depth interviews with content researchers to develop crucial sub-criteria for evaluating the quality and effectiveness of geoheritage interpretation. The sub-criteria include subject expertise, interpretive medium, program design, interpretive principles, location specific information, and interactive educational experiences. The present sub-criteria serve as the foundation for an evaluation framework that may be used to assess current interpretation methods and guide future improvements. This framework provides a systematic approach for geopark managers and interpreters to evaluate and enhance interpretive services, ensuring adherence to global standards and meeting the specific needs of LUGG. Moreover, this paradigm specifically tackles previous criticisms of LUGG's interpretive efforts, particularly on the accuracy of geological content, the scientific rigour of the information provided, and the overall quality of interpretive media.

This research significantly contributes to the ongoing efforts to improve heritage interpretation inside geoparks by developing a complete set of evaluation criteria. The existing framework is not only applicable to LUGG but also functions as a model that may be modified and applied in other geoparks in Malaysia. The framework is expected to significantly contribute to the continuous improvement of historical interpretation; hence, enhancing the educational and conservation outcomes at geoparks.

In essence, the understanding and explanation of geoheritage materials play a vital role in properly communicating the significance of geological heritage to the general population. By effectively adopting it, we may greatly improve our efforts to preserve and conserve our geological resources. However, without comprehensive assessment and continuous improvement, interpretation services may become ineffective or even harmful. The paradigm developed in this study provides a robust tool to ensure that interpretive services in LUGG and other geoparks are effective, accurate, and engaging, which results in a deeper public understanding and appreciation of natural heritage material.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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