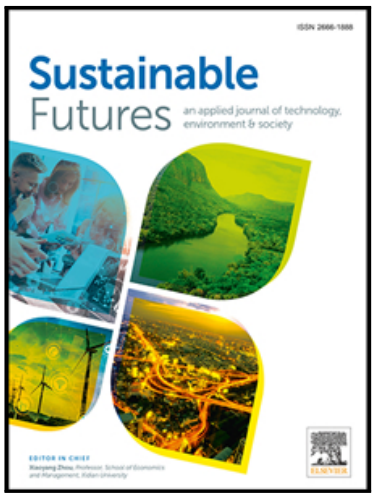

Next-generation core competency gaps for disaster risk management and preparedness in UNESCO-designated heritage sites

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Highlights

- UNESCO site actors exhibit high proficiency in DRM next-generation core competencies
- Respondents' job position and age are significant variables of DRM competencies
- Damages during past disasters influenced levels of DRM competencies
- Holistic DRM proficiency is a significant predictor of site disaster preparedness
- Competent UNESCO actors are key to heritage conservation for sustainable futures

Title Page

Next-generation core competency gaps for disaster risk management and preparedness in UNESCO-designated heritage sites

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CRediT authorship contribution statement
Conceptualization**, E.E.;** methodology**, E.E.;** formal analysis**, E.E.;** resources**, A.S.;** data curation**, E.E.;** writing—original draft preparation**, E.E.;** writing—review and editing**, E.E. and A.S.;** visualization**, E.E.;** supervision**, A.S.**

Abstract
Heritage plays a critical role in sustainability. The absence of studies examining core competencies among UNESCO actors for disaster risk management (DRM) and preparedness in heritage sites prompted this survey. Respondents from 59 countries revealed a high rating of all listed competencies with significant discrepancies concerning relationship-building requiring attention. Additionally, substantial variations in competencies were linked to factors such as age, job positions, and previous experiences with disaster damages. Holistic DRM proficiency is the primary predictor of disaster preparedness within heritage sites. Thus, enhancing preparedness through experiential learning and coordinated knowledge-sharing mechanisms will preserve our collective heritage for sustainable futures.

Introduction
Heritage, encompassing tangible and intangible aspects, plays a transformative role in nurturing sustainable futures. Physical artefacts and built heritage are sometimes more prominent in the discourse but Botta [1] emphasises the inclusion of intangible heritage in the process of future making. Moreover, engaging with the past is recognised by Sandford [2] as integral to crafting future trajectories due to the deeper insights and participatory approaches that are gained. Specifically, a recent study by Bassily et al. [3] emphasizes how built heritage contributes to local resilience and sustainability in various heritage sites by fostering strong place attachment and socioeconomic activities.

Also, the significance of heritage in guaranteeing sustainable futures is widely acknowledged. Trillo et al. [4] explain such consensus as primarily owing to the far-reaching effects of heritage on various domains such as political aspects, ethical contemplation, and the development of local economies. In addition, sustainability, considered both a goal and a means, demands professionals attuned to its transformative potential [5]. Hence, we consider professionals such as actors responsible for managing heritage sites that link us to the past, which must be preserved for future generations are an essential component in forging sustainable futures. Consequently, the focus of this study centres on exploring the disaster risk management (DRM) competencies of the professionals involved with overseeing UNESCO-designated heritage sites globally.

Three distinct categories of sites, each bearing exceptional natural or cultural significance are recognised by UNESCO: Global Geoparks (GGs), Biosphere Reserves (BRs), and World Heritage Properties (WHPs). While GGs stand as guardians of unique geological wonders, BRs are cradles of biodiversity conservation landscapes, and WHPs hold historical and cultural treasures of universal importance [6]. As of

October 2023, these UNESCO-designated treasures span the globe with 195 GGs, 748 BRs, and 1,199 WHPs, sited within 48, 168, and 134 countries, respectively.

Beyond being seeming passive repositories of nature and history, these UNESCO sites (GGs, BRs and WHPs) support sustainable development by intentional conservation and preservation of nature to provide the present generation, with a glimpse of the past and retain the same for those yet unborn. The contributions of these sites have also been connected to the improvement of the quality of life [7]; and the advancement of multi-level initiatives socially, economically, and environmentally [8]. Hence, significant losses of these sites would not only strip its beneficiaries of their natural and cultural legacies but threaten Agenda 2030, which the United Nations set out as an action for people, the planet and prosperity.

Currently, a disconcerting reality emerges as UNESCO-designated sites are facing threats by increasing disasters. Pavlova et al. [9] and [10] indicate that over 2,000 UNESCO sites are exposed to an array of natural hazards. Moreover, the analysis of threats to heritage sites by UNESCO [11] encompasses a wide range of potential dangers, including buildings and development, transportation and services infrastructure, pollution, biological resource use and modification, physical resource extraction, temperature changes, rain, dust, visitor pressure, illegal activities, climate change, severe weather events, geological events, and invasive or alien species. Drawing from several studies, Falk and Hagsten [12] highlight both human and natural threats to heritage sites. These threats include climate change, drought, heavy rains, geological hazards such as earthquakes, volcanic eruptions, avalanches, landslides, extreme weather, storms, wildfires, sea level rise, air pollution, acid rain, over-tourism, crowding, urbanization, war, terrorism, conflicts, and vandalism.

While the impacts of natural hazards on heritage sites are severe, threats such as air pollution, which causes deterioration and corrosion [13] and urbanization, which impacts historical skylines [14], along with the pressure of over-tourism identified by Frey and Briviba [15], can be more insidious and gradual. Furthermore, the intensification in both the frequency and potency of human and nature-induced hazards compounds the challenge, making them increasingly unpredictable. In recognition that the occurrence of natural hazards, including their frequency and intensity, remains beyond our control, our focal point in this study inevitably shifts towards proactive measures that mitigate hazards' impact when they inevitably strike. It is within this context that the current study assumes its critical role, focusing on the assessment of DRM competencies held by UNESCO site managers and their dedicated staff.

Whereas Eze and Siegmund [16] identified competency gaps among UNESCO actors in the application of innovative disaster risk reduction (DRR) technologies and approaches, their study focused only on a specific aspect of competency. They

emphasized the need for a comprehensive investigation into the broader scope of DRM competencies possessed by UNESCO actors. Such an in-depth examination is crucial for designing tailored professional development programs that address all necessary competencies for effective DRM. This current study aims to fill this gap by providing a holistic assessment of DRM competencies among UNESCO site actors, ensuring a more robust foundation for developing targeted training and capacity-building initiatives.

Disaster risk management (DRM) in UNESCO sites

According to the United Nations General Assembly [UNGA] [17], DRM entails the implementation of DRR policies and strategies with the primary objectives of forestalling the emergence of new disaster risks, reducing the existing disaster risks, and effectively handling any residual risks. These actions are expected to be guided by the Sendai Framework for Disaster Risk Reduction of the United Nations International Strategy for Disaster Reduction (UNISDR) [18], link sustainable development and climate change adaptation, and could take prospective, corrective, compensatory, community-based, or local and indigenous peoples' approaches [17]. Therefore, DRM is anticipated to enhance resilience and result in a significant decrease in disaster-related losses within UNESCO sites.

Recent studies have undertaken inquiry into different aspects of DRM with a focus on UNESCO-designated sites. Durrant et al [19] found that WHP managers neither had sufficient access to DRM strategies nor practical experience in DRM implementation. Their study was, however, delimited to risk perception. Furthermore, the study of Garcia [20] provides a strong connection between DRM and cultural heritage preservation, with advocacy for international collaboration for knowledge exchange such as sharing of good practices and learning experiences.

The Emergency Preparedness and Response Unit of UNESCO is actively involved in improving the prospect of DRM in designated sites in addition to other associated international organisations such as the International Scientific Committee for Risk Preparedness (ICOMOS-ICORP), and the International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM). Both ICOMOS-ICORP and ICCROM foster DRM, disaster preparedness and cultural heritage protection from natural and human disasters by providing education, training, research, advocacy, and information dissemination services to WHPs.

These organisations have produced comprehensive documents and reading resources related to DRM in UNESCO sites [21] [22] [23]. While it is anticipated that UNESCO site actors, including managers and staff, possess significant DRM knowledge, a thematic survey report by Pavlova et al [6] reveals a deficiency in risk assessment and management plans within numerous BRs and GGs. Surprisingly, the assessment of DRM competencies possessed by UNESCO site actors has received

limited, if any, attention thus far. Hence, this study marks the initial step towards addressing this critical gap.

Disaster risk management core competencies

There is no universally accepted definition for the term competency. An earlier definition by Strebler et al [24] presents competency as either a set of behaviours that individuals need to exhibit or as minimum performance standards. However, the concept has continued to evolve. Hoffman [25] outlines three primary viewpoints found in the literature regarding the definition of competency – as an individual's observable performance, the standard or quality of the outcomes resulting from their performance, or the inherent attributes of the individual. Some studies tend to combine at least two of these viewpoints. For example, the definition of Wong [26], and Pharaoh and Visser [27] regard competency as a set of observable and measurable attributes or success factors individuals require for effective performance at work.

The diverse meanings of the concept of competency emphasize the necessity of clarifying its usage intentions [25]. Therefore, we clarify that in this study, we adopt the term competency to incorporate two of the three viewpoints identified by Hoffman [25] – respondents' inherent attributes and their performance regarding DRM. Hence, competency is considered as UNESCO site actors' internal DRM attributes and job performance. Specific attention is given to core competencies. Core competencies refer to shared learning experiences that integrate various skills and focus on strategies unifying members of an organisation [28]. Aside from helping to frame research, core competencies are useful for setting performance standards, development of job descriptions and learning outcomes for educational programmes, candidate selection and performance evaluation [28].

This study extends the output of Feldmann-Jensen et al. [28] Through a systematic four-step process, they devised a comprehensive framework comprising 13 core competencies nested within three categories and their corresponding measurements, to address environmental challenges and bolster community resilience in an era of high turbulence, uncertainty, and complexity (Figure 1). Termed the Next Generation Core Competencies, this framework is designed to meet the demands of the dynamic environmental landscape beyond 2030. Hence, conducting a study to evaluate the proficiency of UNESCO site actors in these competencies represents a substantial and pioneering contribution to heritage conservation. This inquiry, which evaluated 31 out of the total 58 measures of the DRM core competencies (Figure 1), not only breaks new ground but also holds futuristic implications for the sustainability of UNESCO sites, extending the achievement of sustainable futures beyond the scope of global policies like Agenda 2030 and SFDRR.

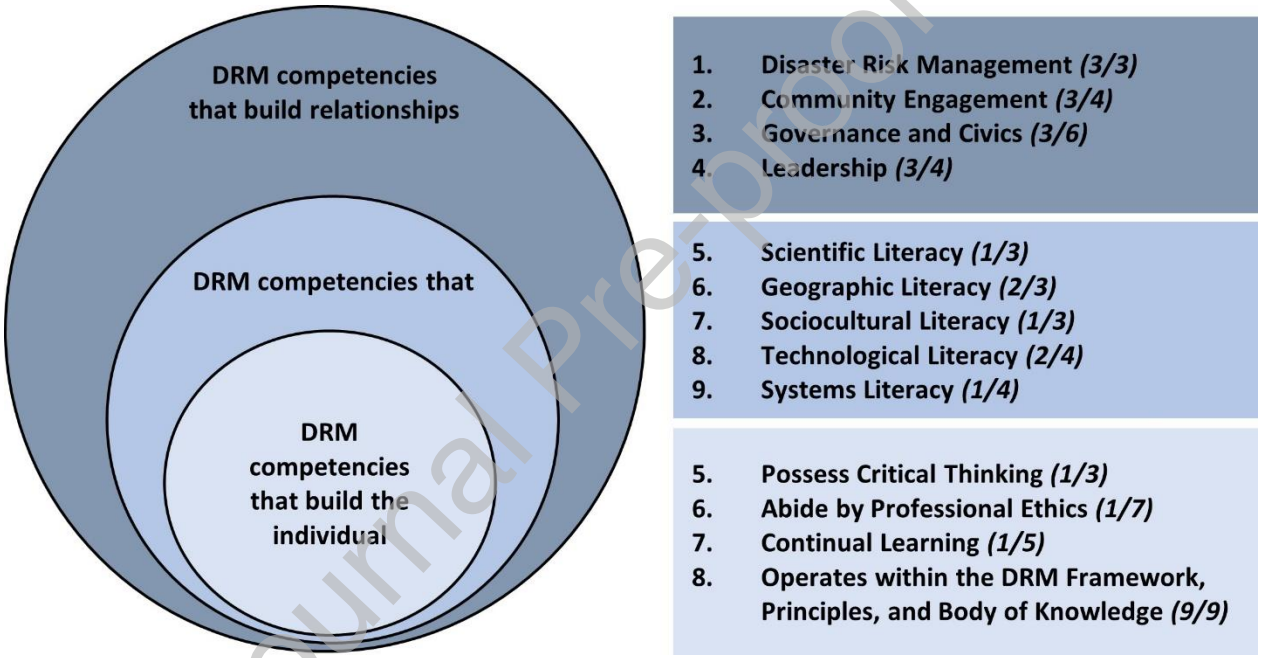

Figure 1: Nested relationship of next-generation DRM core competencies tested in this study. The numbers in parentheses indicate the chosen number out of the total available measures for each competency.
Adapted from Feldmann-Jensen et al. [28]

Disaster preparedness

The term disaster preparedness is defined by UNISDR [29] as the sum of knowledge and capabilities developed in anticipation of disasters to effectively respond to and recover from their impacts. Furthermore, UNISDR [29] describes disaster preparedness to include aspects such as contingency planning, coordination, evacuation procedures, dissemination of public information, simulations, and the stockpiling of equipment. Recent research, exemplified by Nikkanen et al. [30], presents numerous factors influencing preparedness, including personal attributes,

socioeconomic conditions, risk perception, and prior experiences with disasters. Moreover, Eze and Siegmund [31] identified disaster awareness and resource availability as significant predictors of disaster preparedness at UNESCO-designated sites.

Aligned with these identified factors, this research endeavours to assess the disaster preparedness of UNESCO site actors by scrutinizing their expression of next-generation core competencies regarding DRM. These professionals play a crucial role in DRM implementation and the facilitation of disaster preparedness within these sites. Sutton and Tierney [32] notably emphasize the indispensable nature of human resources as pivotal assets essential for effective DRM and preparedness efforts. Evaluating the DRM competencies of UNESCO actors and correlating these with the disaster preparedness of their respective sites remains an unexplored domain in existing literature, particularly concerning factors akin to those highlighted by Nikkanen et al. [30]. Factors such as age, gender, educational attainment, length of service, household income adequacy, UNESCO site classification, site location, past disaster consequences, and the extent of damages incurred from previous disasters are meticulously examined in this study.

Aims and objectives of this study

This study records the first known efforts to unveil the levels of DRM next-generation core competencies possessed by UNESCO site actors and relate the same to site disaster preparedness. It provides an overview of the inherent attributes of respondents and their performance concerning DRM in UNESCO sites. Beyond providing a state-of-the-art on the subject, the study provides crucial aspects of focus for performance evaluation and future-oriented training development. The overarching question of the study is 'What DRM core competencies are held by UNESCO site actors and how do these competencies relate to disaster preparedness of UNESCO sites?'

Our specific objectives seek to answer four research questions:

1. What are the levels of DRM next-generation core competencies possessed by UNESCO site actors?
2. How do demographic factors, disaster exposure, disaster consequences, and participation in training programs influence ratings of DRM next-generation core competencies among UNESCO site actors?
3. What are the dimensions of DRM next-generation core competencies among UNESCO site actors?
4. What is the relationship between expressed DRM next-generation core competencies by UNESCO site actors and disaster preparedness in UNESCO sites?

Methods

Design

This research adopted a descriptive survey methodology, as described by Kothari [33], which aims to illustrate the current situation among selected participants using specific variables. This design was selected as it conforms to the aim of this study, which investigated the levels of DRM next-generation core competencies possessed by UNESCO site actors in association with the levels of disaster preparedness of UNESCO sites. Moreover, Eze et al. [34] describe survey results as essential for information-gathering for designing tailor-made professional development programs.

In this study, responses collected using an adapted questionnaire were analyzed to assess the next-generation disaster risk management (DRM) core competencies held by UNESCO site actors and the emergency preparedness of their sites. The core competencies were evaluated using a 7-point Likert-type scale with 31 items, ranging from strongly disagree (1) to strongly agree (7), based on the competencies designed by Feldmann-Jensen et al. [28] and illustrated in Figure 1. In addition, the preparedness items required respondents to answer with 'Yes', 'No', or 'Not applicable'. Additional questions focused on the demographic characteristics of the respondents, allowing them to select their preferred responses from predefined options. The questionnaire is herewith attached as Supplementary Material S1.

Participants sampling and data collection procedures

Data was collected for this study through an online survey distributed through Survey Monkey to 1,009 email addresses of UNESCO actors globally. These actors are site staff, site managers, staff of UNESCO national commissions, and focal persons on UNESCO sites who are trained and charged with overseeing our collective heritage. The demographic information of respondents is provided as Supplementary Material S2. Given the clear definition of the intended target respondents as actors within UNESCO-designated sites, this study utilized two convenience non-probability sampling methods: harvested email lists and river sampling. The harvested email list method, according to Fricker [35], involves extracting email addresses from online sources, while the river sampling technique described by Lehdonvirta et al [36] entails sending targeted invitations to the study via clickable links directed at a preselected population.

The questionnaire was distributed in two phases, spanning from August 2022 to February 2023 and then from September to October 2023. This double circulation aimed to boost response numbers with reminders sent during both phases. Three reminder emails were dispatched in October 2022, November 2022, and February 2023 during the first phase, while two reminders were issued in the second phase after the fourth and fifth weeks following the relaunch. Despite these efforts, only 141 responses were gathered, resulting in a response rate of 13.98%. However, the received responses represented around 55 countries, encompassing diverse sites, continents, and contexts. Although the responses might lack representativeness due to the limited number, they are still valuable for offering an initial exploration into

the DRM next-generation core competencies held by responding UNESCO actors. In personal communication with a UNESCO headquarters staff member, the low participation was attributed to their hectic schedules. Additionally, Pharaoh and Visser [27] explain that survey fatigue and a tendency to receive numerous surveys might contribute to the reluctance to respond to surveys that prospective respondents considered 'non-essential'.

Data collection instrument development and testing

Before this research, no prior survey known to the authors had assessed the DRM core competencies of UNESCO actors using a similar questionnaire sourced from Feldmann-Jensen et al. [28], detailing the next-generation DRM core competencies. Concurrently, the 10 items on emergency site preparations were extracted from UNESCO, ICOMOS & IUCN [37]. In developing the main section of the questionnaire, priority was given to items related to relevant frameworks, principles, and literature covering DRM core competencies. These competencies aim to develop the UNESCO actor as an individual, a practitioner, and within work-community relationships. Purposeful selections were made from all 13 core competencies outlined by [28] as depicted in Figure 1.

To ensure the questionnaire's validity and reliability, two meticulous steps were undertaken. Initially, the designed questionnaire underwent rigorous face validity assessment. Two Professors and (post)doctoral researchers from the Department of Geography at XXXXXXXXX University of Education were consulted to scrutinize the questionnaire items regarding relevance, clarity, and alignment with the research objectives. The feedback received from six validators, including a professor, was meticulously reviewed, and incorporated into the final version. Based on their suggestions, certain items were omitted to streamline the questionnaire. Additionally, the final version underwent machine translation from English into various UNESCO languages (Arabic, Chinese, French, Portuguese, Russian, and Spanish) and was carefully scrutinised by native speakers before distribution. Subsequently, a pilot study was conducted among selected respondents in European UNESCO sites, yielding 41 responses. An assessment of the internal consistency of the DRM next-generation core competency items using Cronbach's Alpha resulted in a remarkable figure of .976, indicating an exceptionally high level of internal consistency (> 97%) among the questionnaire items. Following the analysis of the complete set of responses (*n* =141), the reliability measure yielded .974, further affirming the questionnaire's reliability and consistency across the sample.

Data analyses

The collected survey responses were analysed using the IBM SPSS Statistics (Version 29). Descriptive statistics were used for respondents' characteristics, levels of expressed DRM next-generation core competencies, site disaster preparedness, and cluster characteristics. To interpret the output of the mean ratings of the DRM next-

generation core competencies, we designated $\bar{X}$ = ≥ 4.0 to indicate a high rating. Independent *t*-test and analysis of variance (ANOVA) were conducted to determine the differences in mean DRM next-generation competencies ratings based on respondent characteristics. Correlation tests provided insights into the association among the groups of competencies in Figure 1 (i.e., competencies that build the individual, practitioner, and relationships).

Furthermore, for dimension reduction, we employed the Principal Component Analysis (PCA). The PCA is a mathematical method used to condense complex data into a smaller set of uncorrelated dimensions known as principal components (PCs) and is applicable in various scientific fields [38]. One of the key strengths of PCA lies in its non-parametric nature, allowing it to be a robust and versatile tool for data analysis without reliance on specific distribution assumptions [39]. According to Eze and Nwagu [40], PCs are typically considered significant if they have Eigenvalues of 1.00 or higher. In this study, the PCA was used to reduce the dimensionality of the DRM core competencies to effectively identify their key components as rated by respondents. In this way a simple presentation of the complexity of the competency items is easily categorised and presented to readers, retaining the most significant information, while enhancing the interpretability of the results. The PCA analysis was conducted using IBM SPSS Statistics (Version 29), employing varimax rotation with Kaiser normalization. Before conducting PCA analyses, the collected data underwent an assessment to ensure suitability for factor analysis. The Kaiser-Meyer-Olkin (KMO) value, which was calculated to be .908, surpassed the recommended threshold of .60 as proposed by Kaiser [41]. Additionally, Bartlett's test of sphericity yielded a significant value of (.000), affirming the factorability of the data.

To identify the grouping of disaster preparedness based on DRM next-generation core competency ratings, cluster analyses were implemented. Cluster analysis is a method aimed at categorizing similar data into distinct clusters without overlaps, with robust clustering techniques serving various purposes, including anomaly detection, improved data comprehension, hypothesis formulation, recognition of similarity patterns among instances, data compression, and more [42] [43]. Among the clustering algorithms, Reddy and Vinzamuri [44] opine that partitional and hierarchical clustering stand out for their simplicity and widespread use. In this study, a partitional clustering approach was utilized to classify observations into *k* clusters, employing the criterion function of minimizing the distance between points within each cluster. This technique was chosen to enhance the understanding of the dataset and unveil patterns of DRM next-generation core competencies of UNESCO actors and the disaster preparedness of their sites. Firstly, a two-step cluster analysis was performed to unveil the optimum number of clusters for the data. This was followed by a *k*-means cluster analysis to classify the data into the number of clusters previously obtained in the first step. Variables used for the cluster analyses include

the mean ratings of items in the identified principal components and the disaster preparedness responses.

Ethical considerations

The questionnaire used in this study received approval from the Department of Geography at XXXXXXXXX University of Education following a comprehensive self-administered ethical review that determined no potential harm to respondents. This review allowed the study to proceed without the need for a voting process within the ethical committee. Consequently, the study strictly adhered to established scientific practices, encompassing elements such as informed consent, maintaining anonymity of responses, ensuring data privacy, and upholding participants' rights to withdraw from the study at any point, aligning with ethical codes including those outlined by the American Psychological Association [APA] [45]. Throughout the study, five individuals chose to withdraw voluntarily.

Results

Levels of expressed DRM next-generation core competencies

A total of 83 responses were fully completed and used for the analyses. Most respondents agree with all the listed item statements on DRM next-generation core competencies that build the individual, practitioner, and relationships, with a cluster mean of 5.17 (Table 1). An individual-building competency item related to the demonstration of professional ethics had the highest mean responses ($\bar{X}$ = 6.05), while a relationship-building item about access analyses of power, policy and legal parameters related to disaster risk issues ($\bar{X}$ = 4.47) was the least. Whereas the overall mean of DRM next-generation core competencies of the respondents is $\bar{X}$ = 5.17, the practitioner-building competency items had the highest mean responses of the three categories ($\bar{X}$ = 5.32). The individual-building and relationship-building competencies had a mean response of $\bar{X}$ = 5.26 and $\bar{X}$ = 4.91 respectively. Therefore, there is a positive perception regarding all categories of the listed DRM competencies. However, emphasis may be needed on developing relationship-building competencies to ensure a holistic approach to disaster risk management.

Table 1

Results of UNESCO actors rating in the listed DRM next-generation core competencies

DRM next-generation core competency items	Mean	Std. Deviation
I possess critical thinking for problem identification and solutions	5.66	1.28
I demonstrate Professional ethics of respect, justice, integrity, and selfless service	6.05	1.13
I engage in continual learning and knowledge expansion	5.92	1.14

I consider all hazards, phases, stakeholders, and impacts relevant to disasters	5.30	1.48
I expect future disasters and develop disaster-resistant and disaster-resilient communities	5.14	1.63
I utilize sound risk management principles in assigning priorities and resources	4.59	1.49
I ensure unity of efforts among all community members to manage disaster risk	4.94	1.43
I create and sustain a team atmosphere to facilitate communication	5.52	1.39
I facilitate synchronous activities among all relevant stakeholders to achieve a common purpose	5.34	1.37
I use creative and innovative approaches to solving disaster challenges	4.96	1.47
I value a science and knowledge-based approach for continuous improvement	5.82	1.21
I consider, utilize, and value the growing body of disaster risk management literature for building disaster-resilient communities	5.08	1.50
I appreciate scientific processes and how their applications benefit humanity	5.89	1.30
The world is made of physical, built, and social systems, which interact in multifaceted ways, producing varying levels of risk and vulnerability	5.76	1.14
People and places are connected in a dynamic network of global relationships	5.73	1.28
I help others understand the relationship between social factors and disaster risk concentration	5.14	1.40
I use existing appropriate technologies in disaster risk management practice	4.55	1.70
I consider ethical, legal, and social implications when determining the appropriateness of a technology application for disaster risk management	4.84	1.73
I work in partnership with others and utilize a range of resources available within the system to establish an innovative solution to a pressing problem	5.33	1.52
I clearly communicate and explain hazard risks to a wide range of stakeholders	5.01	1.58
I understand and apply disaster risk management frameworks to identify and manage risks	4.84	1.57

I monitor, evaluate, and review risk management processes and outcomes	4.77	1.56
I involve the stakeholders to focus on the disaster risk exposure	4.93	1.56
I facilitate a community learning process through communication, dialogue, negotiation, and cooperation	5.25	1.46
I support community networks through the ongoing improvement of collective disaster risk reduction goals and interventions	4.81	1.56
I identify and analyse a hazard risk issue for action	4.73	1.53
I analyse access to the relational dynamics of, and the ramifications from those in positions of political power, policy, and legal parameters in connection to disaster risk issues	4.47	1.56
I bring people together across sectors to identify and address disaster risk issues at hand	4.66	1.70
I inspire a shared vision with community stakeholders and involve them to contribute to its achievement	4.98	1.57
I empower my staff to successfully pursue our organisation's vision	5.22	1.63
I resolve conflicts that emerge within or between the organization and the community it serves	5.16	1.55
Cluster mean	**5.17**	

n = 83

Factors influencing possession of DRM next-generation core competencies

Ratings of possession of DRM next-generation core competencies by staff members of UNESCO commissions and other focal persons were significantly the highest, while the site staff had the lowest ratings of individual, practitioner, relationship, and overall DRM core competencies (p = .011, .012, .006, and .006 respectively). Respondents aged 55 to 64 years had significantly higher ratings than their counterparts of other age groups in the individual, practitioner, relationship, and overall DRM core competencies (p = .018, .031, .010, and .011 respectively). Respondents who recorded the highest consequences of disasters also had significantly highest ratings of individual, practitioner, relationship, and overall DRM core competencies (p =.021, .061, .013 and .019 respectively). Furthermore, all DRM competency components (i.e., individual, practitioner and relationship) were very highly significantly associated with the overall competency score (r > .940**). In summary, there is a noticeable gap in rated competencies at the site level compared to higher administrative levels. Additionally, older respondents and those with more disaster experience among UNESCO actors show enhanced competencies. The strong correlation between individual competency components and overall competency ratings suggests that

improving one area of competency could positively influence the overall DRM competence of UNESCO actors.

Table 2
Results of significant difference tests on UNESCO actors' mean rating of listed DRM core competencies

Respondents' characteristics	Levels	n	DRM Competency overall	DRM competency: Individual	DRM competency: Practitioner	DRM competency: Relationship
Site type	World Heritage Site	18	4.98	5.05	5.093	4.79
	Biosphere Reserve	62	5.25	5.34	5.40	4.98
	Others	3	4.87	5.07	5.19	4.30
Site location	Africa	15	5.52	5.58	5.53	5.40
	The rest of the world	68	5.10	5.19	5.28	4.80
Job title	UNESCO site staff	19	4.49	4.66	4.68	4.05
	UNESCO site manager	24	5.29	5.34	5.39	5.13
	Others	40	5.43 **	5.51 *	5.59 *	5.19 **
Age range	25-34 years	11	5.36	5.45	5.45	5.14
	35-44 years	18	4.54	4.67	4.67	4.20
	45-54 years	25	5.29	5.35	5.53	5.01
	55-64 years	19	5.77	5.80	5.80	5.69
	65+ years	4	4.99 *	5.03 *	5.36 *	4.64 *
Gender	Male	42	5.39	5.45	5.56	5.15
	Female	34	5.03	5.12	5.13	4.78
	Others	1	5.52	5.40	5.86	5.44
Educational level	Non-university graduate	3	5.83	5.98	5.76	5.63
	University-level education	9	5.01	5.03	5.19	4.83
	Postgraduate degree	65	5.23	5.31	5.38	4.98
Length of service	0-5 years	25	5.05	5.09	5.24	4.84
	6-10 years	21	5.21	5.32	5.31	4.95
	11+ years	31	5.39	5.47	5.53	5.14
Sufficiency of collective (family) income	No	12	5.08	5.16	5.25	4.83
	Yes	59	5.31	5.39	5.46	5.07

Housing type	House (free standing)	36	5.48	5.47	5.71	5.31
	Unit/flat (joined to another unit/flat)	16	5.17	5.25	5.24	4.97
	Apartment in a multi-level building	23	4.92	5.10	4.96	4.56
	Other (please specify)	2	4.87	4.97	5.29	4.39
Disaster consequences on site	No consequence	10	4.73	4.7467	5.0143	4.4778
	Gradual (in stages)	33	5.12	5.2343	5.1645	4.9024
	Mild	26	5.08	5.2128	5.2582	4.7308
	Catastrophic/severe	14	5.79	5.7952	6.0306	5.5794
Training attendance	No	16	4.90	5.0875	4.9375	4.5556
	Yes	33	5.38	5.4182	5.5844	5.1650
Damages from past disasters	None	24	4.72	4.83	5.10	4.26
	2	13	5.61	5.62	5.66	5.55
	3	3	4.60	4.53	4.86	4.52
	Moderate	19	5.08	5.25	5.14	4.77
	5	12	5.05	5.21	4.93	4.89
	6	5	5.75	5.73	6.11	5.51
	A lot of damages	7	6.21 *	6.23 *	6.24 *	6.14 *

* = p <.05; ** = p <.01

Dimensions of expressed DRM next-generation core competencies

The PCA results showed four distinct components (Table 3) with eigenvalues above 1, explaining 76.18 % of the total variance in the data set. Four factors ensued with items corresponding to DRM next-generation core competencies relating to (1) individual, practitioner, and relationship components combined; (2) individual and practitioner components combined (3) individual and relationship components combined (4) only the individual component.

Table 3

Results of factors (PCs) from the PCA

DRM next-generation core competency items	PC1	PC2	PC3	PC4	DRM core competency type (category)
I use creative and innovative approaches to solving disaster challenges	**0.49**	0.25	0.41	0.45	Operation within Disaster Risk Management Framework(I)

I consider, utilize, and value the growing body of disaster risk management literature for building disaster-resilient communities	**0.64**	0.30	0.20	**0.51**	Operation within Disaster Risk Management Framework(I)
I help others understand the relationship between social factors and disaster risk concentration	**0.7**	0.28	0.11	0.37	Sociocultural Literacy(P)
I use existing appropriate technologies in disaster risk management practice	**0.79**	0.06	0.19	0.39	Technological Literacy(P)
I consider ethical, legal, and social implications when determining the appropriateness of a technology application for disaster risk management	**0.74**	0.21	0.13	0.34	Technological Literacy(P)
I work in partnership with others and utilize a range of resources available within the system to establish an innovative solution to a pressing problem	**0.58**	0.35	**0.50**	0.20	Systems Literacy(P)
I clearly communicate and explain hazard risks to a wide range of stakeholders	**0.89**	0.19	0.12	0.19	Disaster Risk Management(R)
I understand and apply disaster risk management frameworks to identify and manage risks	**0.89**	0.19	0.08	0.22	Disaster Risk Management(R)
I monitor, evaluate, and review risk management processes and outcomes	**0.86**	0.11	0.29	0.13	Disaster Risk Management(R)
I involve the stakeholders to focus on the disaster risk exposure	**0.82**	0.11	0.29	0.35	Community Engagement(R)
I support community networks through the ongoing improvement of collective disaster risk reduction goals and interventions	**0.84**	0.05	0.18	0.17	Community Engagement(R)
I identify and analyse a hazard risk issue for action	**0.83**	0.17	0.26	0.07	Governance and Civics(R)
I analyse access to the relational dynamics of, and the ramifications from those in positions of political power, policy, and legal parameters in connection to disaster risk issues	**0.84**	0.11	0.32	0.19	Governance and Civics(R)
I bring people together across sectors to identify and address disaster risk issues at hand	**0.81**	0.06	0.34	0.28	Governance and Civics(R)

I inspire a shared vision with community stakeholders and involve them to contribute to its achievement	**0.66**	0.25	0.60	0.08	Leadership(R)
I empower my staff to successfully pursue our organisation's vision	**0.52**	0.41	0.48	0.11	Leadership(R)
I resolve conflicts that emerge within or between the organization and the community it serves	**0.62**	0.26	0.52	0.14	Leadership(R)
I possess critical thinking for problem identification and solutions	0.04	**0.78**	0.02	-0.01	Critical Thinking(I)
I demonstrate Professional ethics of respect, justice, integrity, and selfless service	0.17	**0.88**	0.05	0.11	Professional Ethics(I)
I engage in continual learning and knowledge expansion	0.22	**0.84**	0.17	0.12	Continual Learning(I)
I value a science and knowledge-based approach for continuous improvement	0.18	**0.65**	0.39	0.34	Operation within Disaster Risk Management Framework(I)
I appreciate scientific processes and how their applications benefit humanity	0.29	**0.68**	0.42	0.11	Scientific Literacy(P)
The world is made of physical, built, and social systems, which interact in multifaceted ways, producing varying levels of risk and vulnerability	0.19	**0.79**	0.22	0.26	Geographic Literacy(P)
People and places are connected in a dynamic network of global relationships	-0.05	**0.74**	0.24	0.19	Geographic Literacy(P)
I create and sustain a team atmosphere to facilitate communication	0.25	0.42	**0.62**	0.3	Operation within Disaster Risk Management Framework(I)
I facilitate synchronous activities among all relevant stakeholders to achieve a common purpose	0.43	0.34	**0.62**	0.30	Operation within Disaster Risk Management Framework(I)
I facilitate a community learning process through communication, dialogue, negotiation, and cooperation	**0.51**	0.25	**0.69**	0.17	Community Engagement(R)

I consider all hazards, phases, stakeholders, and impacts relevant to disasters	0.30	0.47	-0.03	**0.60**	Operation within Disaster Risk Management Framework(I)
I expect future disasters and develop disaster-resistant and disaster-resilient communities	0.32	0.25	0.45	**0.59**	Operation within Disaster Risk Management Framework(I)
I utilize sound risk management principles in assigning priorities and resources	0.37	0.209	0.14	**0.67**	Operation within Disaster Risk Management Framework(I)
I ensure unity of efforts among all community members to manage disaster risk	0.40	0.09	0.33	**0.64**	Operation within Disaster Risk Management Framework(I)

Notes:
(I) = DRM competencies that build the individual
(P) = DRM competencies that build the practitioner
(R) = DRM competencies that build the relationships

In Table 3 items are ordered to show component groupings. The grey shading shows highly positive factor loadings (≥ 0.50). Two components contain ambiguous items with two highly positive loadings. In both cases, items were placed in the component with the higher loading. We subsequently present the deductive interpretations and labels of the four identified components as dimensions of next-generation core competencies for DRM among UNESCO actors. These dimensions illustrate the varying combinations of competencies possessed by UNESCO actors. While some respondents exhibit a holistic competency that encompasses all three components, others demonstrate different combinations of these competencies, as described below.

Dimension 1: Holistic disaster risk management proficiency

Items with high loadings contained in this dimension encompass the individual, practitioner, and relationship components of the tested DRM next-generation core competencies. More than half of all the tested items and almost two-thirds of the thirteen competency measures were contained in this dimension. While five items are directly related to measures of DRM frameworks at personal and interpersonal levels, the other twelve items are spread among measures of sociocultural literacy, technological literacy, systems literacy, community engagement, governance and

civics, and leadership. Thus, the caption holistic DRM proficiency is justified as this dimension incorporates a vast array of DRM next-generation core competencies, and multifaceted literacies linking individual capabilities, DRM innovative practices and interpersonal relationships.

Dimension 2: Systems thinking and professionalism

The collection of competencies in this dimension reflects a systemic approach to problem-solving and a commitment to professionalism in DRM. The items within this component indicate a mindset geared towards holistic thinking, ethical conduct, continual learning, and a strong appreciation for knowledge-based approaches and scientific processes. An understanding of the interconnectedness of global systems, and the use of scientific processes for continuous improvements warrants the label of systems thinking and professionalism for this dimension.

Dimension 3: Collaborative coordination and engagement

The third dimension contains competencies that emphasize the facilitation of effective communication, collaboration, and coordination among various stakeholders for DRM. Together, these items covering only two measures (operation within the DRM framework and community engagement) highlight the ability to create and sustain a conducive team environment that fosters open communication, synchronous activities, and collaborative learning. These items are crucial for building relationships, sharing information, and collectively addressing disaster challenges. The choice of the caption collaborative coordination and engagement is due to the cooperation among multiple stakeholders as facilitated by the respondents.

Dimension 4: Proactive resilience planning

This last dimension from the PCA results focuses on elements of planning and responding to disaster risks for resilience. All items are solely related to the individual DRM competency and cover strategic planning, resource allocation, inclusive and collective actions, and resilience building. The forward-thinking approach warrants the adoption of the term 'proactive' in the label. Moreover, a combination of comprehensive consideration of diverse elements and sound principles within DRM initiatives for resource allocation points to increased effectiveness.

DRM next-generation core competencies and site disaster preparedness

The cluster analyses yielded four clusters with a good measure of cohesion and separation of the data (Fig 2). These distinct clusters correspond to very high (cluster 1), very low (cluster 2), high (cluster 3), and moderate (cluster) levels of DRM core competency based on the four-factor PCs. Cluster 1 had the highest membership (n = 31), followed by Cluster 3 (n = 30). The least group membership was recorded in Cluster 2 (n = 5). There is a consistently higher percentage of sites prepared for disasters in all clusters except Cluster 2 (Table 4). Hence, the sites of the majority of

those who expressed low DRM next-generation core competencies were also unprepared for disasters.

There was a weak positive but statistically significant relationship of site preparedness with means of the four principal components: PC1 (R = .301**), PC2 (R = .275*), PC3 (R = .292**), and PC4 (R = .272*). Moreover, stepwise regression results (Table 5) show only PC1 mean (i.e., holistic disaster risk management proficiency) as the most relevant predictor of sites' disaster preparedness (R = .301, R^2 = .09, p = <.01).

Thus, the cluster analysis identified four distinct clusters representing different levels of DRM core competency: very high, high, moderate, and very low. Additionally, there exists a minor correlation between the possession of DRM competencies and disaster preparedness across UNESCO sites. Similarly, when evaluating predictors of disaster preparedness across all competency dimensions from the PCA, only the holistic DRM competency dimension emerges, suggesting comprehensive DRM competencies as crucial to disaster preparedness in UNESCO-designated heritage sites.

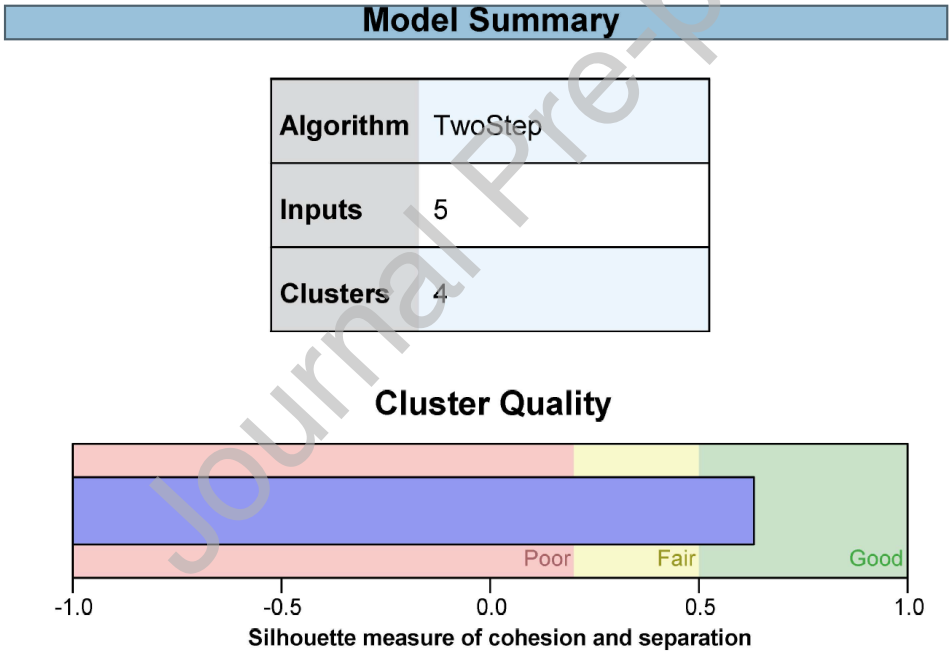

Figure 2: Model summary of cluster analyses

Table 4:
Cluster analyses results

Variables (PC mean)	Minimum	Maximum	Mean	Std. Deviation	Cluster 1		Cluster 2		Cluster 3		Cluster 4	
					PC Centroid	% Prep. (Unprep.)	PC Centroid	% Prep. (Unprep.)	PC Centroid	% Prep. (Unprep.)	PC Centroid	% Prep. (Unprep.)
PC1	1.00	7.00	4.92	1.33	6.13		1.84		4.91		3.52	
PC2	1.00	7.00	5.00	1.31	6.20	25.32	1.84	2.53	4.94	26.58	3.73	10.13
PC3	1.00	7.00	4.99	1.31	6.19	(13.92)	1.81	(3.80)	4.97	(11.39)	3.69	(6.33)
PC4	1.00	7.00	5.09	1.26	6.21		1.91		5.06		3.94	

Notes:
PC = Principal Components
Prep. = Prepared
Unprep. Unprepared

Table 5:
Stepwise regression of predictors of site disaster preparedness

Model		B	Std. Error	Beta	R^2 adj.	F	t
1	(Constant)	1.972	1.293			7.46**	1.53
	PC1 Mean	0.686	0.251	0.301	0.08		2.73**

n =77

Discussion and Implications

The study sought to evaluate the Disaster Risk Management (DRM) core competencies among UNESCO site actors and their connection to disaster preparedness in these sites. Results indicated that most respondents affirmed the listed DRM next-generation core competencies outlined in the study. Factors such as job position, age, and on-site disaster consequences exhibited significant influence on the tested competencies. Moreover, the study identified four principal components delineating the dimensions of competencies held by participating UNESCO actors: holistic disaster risk management proficiency, systems thinking and professionalism, collaborative coordination and engagement, and proactive resilience planning. Notably, respondents with lower DRM next-generation core competencies also demonstrated reduced disaster preparedness, while holistic disaster risk management proficiency emerged as the sole predictor of sites' disaster preparedness.

While UNESCO site actors exhibit a collective strength in possessing robust DRM next-generation core competencies, notable disparities exist across specific competencies, particularly in aspects related to building relationships and demanding attention. Future training initiatives should address this critical skill gap to enhance the competencies among the respondents. According to Feldmann-Jensen et al. [28], all measures of these competencies play a strategic role in preparing the next generation of the DRM workforce. Furthermore, these competencies are also useful for setting performance standards. However, there is a scarcity of studies assessing next-generation core competencies in DRM, limiting further discussion and comparison with previous research. Nevertheless, Bhagavathula et al. [46] utilized similar next-generation core competencies to assess a capacity-building program, highlighting that competencies fostering relationships were the least demonstrated across the three separate training programs they evaluated. Similarly, Durrant et al. [19] suggest a potential oversight among UNESCO site managers in establishing connections with stakeholders, potentially missing out on meaningful relationships and opportunities to leverage shared resources and knowledge.

The data from this study does not clarify why UNESCO national commissions and focal persons showed significantly higher ratings in DRM competencies compared to others. Such disparities underscore the vital need for knowledge sharing among all stakeholders involved. While Durrant et al. [19] suggest training as a means for transferring DRM knowledge from experienced WHP professionals to others, Giliberto and Jackson [47] propose a shift from conventional top-down approaches to more inclusive knowledge exchange solutions across heritage sites and similar settings. The International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) [48] illustrates such collaborative capacity-building formats, as demonstrated in a recent workshop in Mozambique. During this event,

participants collectively developed disaster mitigation, preparedness, and response guidelines through their own field experiences, aiming to integrate these into DRM plans.

In addition, our investigation into DRM next-generation core competencies revealed a trend of higher ratings among older respondents, aligning with existing literature, particularly among emergency nurses. For instance, Yu et al. [49] identified nurses' age, formal education, and engagement in disaster-related training as influential factors in DRM competency. Similarly, Goki et al. [50] noted substantial variations in DRM ratings among nurses based on education level, age, work experience, employment status, and training participation. However, our study did not establish statistical significance in mean DRM competency ratings among respondents based on several factors. The site type, site location, disaster consequences on sites, gender, educational level, training participation, length of service, and socioeconomic characteristics like family income sufficiency and housing type are not significant factors of DRM next-generation core competencies among respondents in our study.

Interestingly, our findings show the significance of damages from prior disasters as a substantial factor influencing the DRM core competencies of UNESCO site actors. Experience with disaster repercussions tends to significantly shape the readiness and ability of individuals to manage future similar events. Onuma et al., [51] opine that persons who have encountered disasters may exhibit an increased risk awareness and better preparedness in comparison to those without such experiences. The relevance of disaster experience as a determinant of disaster preparedness extends the conclusions drawn by Eze and Siegmund [31], who identified disaster awareness and the availability of DRM resources as significant factors influencing disaster preparedness in UNESCO-designated heritage sites.

Increased emphasis should be placed on cultivating comprehensive DRM proficiency among UNESCO site actors. All components and measures encompassing DRM next-generation core competencies frameworks like that of Feldmann-Jensen et al. [28] or more current approaches should serve as a guideline for training initiatives or evaluating same. Nurturing a holistic understanding and application of DRM competencies among UNESCO site actors is critical as it improves the disaster preparedness of the heritage sites they oversee. Thus, the prospects of conserving heritages, fortifying their resilience against disasters, supporting local communities and their economies, and ensuring sustainable socio-environmental futures are thereby improved. UNESCO actors with holistic DRM competencies are better positioned to safeguard our invaluable heritages as irreplaceable assets, serving both current and future generations.

This study marks a significant advancement in assessing Disaster Risk Management (DRM) core competencies among UNESCO actors, with profound implications for capacity-building efforts, heritage conservation, and the pursuit of sustainable futures. It represents the first comprehensive evaluation of next-generation core competencies for DRM in heritage sites, surpassing mere identification of existing skills by illuminating various competency components through advanced analytical techniques and consideration of diverse factors. Our findings underscore the critical importance of holistic DRM competencies in enhancing disaster preparedness within heritage sites while highlighting the role of experiential learning derived from past disaster experiences in shaping preparedness levels. We provide a blueprint for strengthening disaster resilience strategies in UNESCO sites by deepening the understanding of capacity-building needs. Specifically, we advocate for prioritizing the development of relationship-building skills alongside existing DRM competencies to achieve more comprehensive competency levels among UNESCO actors.

Furthermore, our research suggests the incorporation of simulation-based learning into capacity-building programs. Recent studies, such as that by Tasantab et al. [52], have demonstrated that integrating simulation-based experiential learning into DRM education enhances learners' ability to apply knowledge and make critical decisions. Experiential learning not only enriches practical experience but also fosters the capacity to engage with diverse perspectives. Therefore, integrating experiential learning into capacity-building programs can effectively simulate disaster experiences for individuals who lack direct exposure to disasters, thereby enhancing disaster preparedness. This approach holds promise for equipping UNESCO actors with the necessary skills and knowledge to navigate complex disaster scenarios and contribute to the resilience of heritage sites.

Conclusion

This study offers a comprehensive analysis of DRM next-generation core competencies held among UNESCO site actors and how these competencies relate to disaster preparedness. Training initiatives that focus on relational competencies to achieve holistic DRM proficiency are required for comprehensive disaster preparedness in UNESCO sites. Moreover, the value of experiential learning is emphasised by this study as past disaster damages tend to shape DRM competencies among responding UNESCO actors. Thus, case studies and real-life experiences should be incorporated into training activities. To address disparities in competency levels due to age and job positions, inclusive knowledge-sharing exchanges among stakeholders and across site contexts are needed. Our results reveal the need for more studies to develop frameworks aligning with the evolving needs of UNESCO actors for effective DRM in the context of heritage conservation for sustainable futures in the period beyond 2030. Such tailored capacity-building frameworks and subsequent activities become imperative as there are high expectations to witness the accomplishment of major global frameworks such as Agenda 2030 and the

Sendai Framework for Disaster Risk Reduction. Further studies, particularly those employing qualitative methods, are imperative to delve deeper into the development process of these competencies. Qualitative approaches can offer rich insights into the different processes of competency development, shedding light on factors influencing variations in competency levels among individuals. Additionally, qualitative research can provide explanations for observed differences in competency levels, offering a more comprehensive understanding of the underlying dynamics at play.

Limitations of the study

Despite the insights gained from the findings of this study, several limitations are acknowledged. Firstly, our utilization of self-reported data in this study introduces potential response bias, where participants might provide socially desirable responses, possibly impacting the accuracy of the measured concepts. Also, responses may not precisely reflect the actual levels of the variables we measured in the study. Furthermore, the study's cross-sectional design limits the incorporation of temporal aspects into variable analyses, lacking a longitudinal perspective. The generalizability of findings may also be restricted as respondents and their sites may only represent a subset, potentially failing to capture variations in DRM next-generation core competencies and disaster preparedness across different regions and types of sites. To strengthen the reliability and depth of future investigations, it is recommended to complement this research with more comprehensive local or national studies. Additionally, expanding sample sizes in subsequent research can facilitate more rigorous statistical analyses, enhance outcome reliability, improve findings' accuracy, and increase their applicability to diverse contexts. Despite these limitations, this study is pivotal in unveiling the state of the art on the topic of identifying and relating DRM next-generation core competencies of UNESCO site actors to disaster preparedness in UNESCO sites for sustainable futures.

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