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# Digital Literacy and Javanese Cultural Heritage Digitalization in Strengthening Regional Resilience

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# Digital Literacy and Javanese Cultural Heritage Digitalization in Strengthening Regional Resilience

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## ABSTRACT

The development of digital technology has transformed how communities access, preserve, and interact with cultural heritage. Digital Literacy and Javanese Culture Digitalization may therefore play important roles in strengthening Regional Resilience. This study aims to examine the effects of Digital Literacy and Javanese Culture Digitalization on Regional Resilience. A quantitative survey approach was employed, involving 392 respondents who met the predetermined research criteria. Data were analyzed using Structural Equation Modeling (SEM) with Confirmatory Factor Analysis (CFA) to assess construct validity, reliability, and structural relationships. The results show that both Digital Literacy and Javanese Culture Digitalization have positive and significant effects on Regional Resilience. Digital Literacy has a stronger effect ($\beta = 0.77$; C.R. = 5.68; $p < 0.001$), while Javanese Culture Digitalization also has a positive and significant effect ($\beta = 0.55$; C.R. = 2.94; $p = 0.003$). The dominant Digital Literacy indicator concerns respondents' consideration of the social consequences of information shared digitally, while the dominant Javanese Culture Digitalization indicator concerns rediscovering older Javanese cultural content through search and recommendation features. These findings indicate that Regional Resilience is supported by both responsible digital capabilities and accessible digital cultural resources.

**Keywords:** Digital Literacy; Digital Culture; Javanese Culture Digitalization; Regional Resilience.

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## INTRODUCTION

The rapid development of digital technologies has generated profound transformations across various dimensions of contemporary life, including the social, economic, political, educational, and cultural spheres. The emergence of the 4.0 Industrial Revolution and the development of the concept of *Society 5.0* represent a transition toward a society increasingly integrated with advanced digital technologies, including the Internet of Things (IoT), artificial intelligence (AI), big data, cloud computing, and social media. Rather than merely introducing new technological tools, this transformation has fundamentally altered the ways in which people work, communicate, interact, and produce knowledge.[6] Fukuyama (2018) conceptualized *Society 5.0* as a human-centered society in which technological innovation is expected to contribute to the resolution of social challenges and the improvement of human well-being. Castells (2010) the emergence of the network society has transformed patterns of social interaction by enabling individuals and groups to establish relationships, construct meanings, and circulate information across geographical boundaries. Consequently, digital transformation should not be understood solely as a technological transition but also as a profound social and cultural transformation with implications for social cohesion, intergroup relations, identity formation, and peacebuilding[7]

The expansion of digital technologies has also transformed the ways in which cultural heritage is preserved, interpreted, accessed, and transmitted. Cultural digitalization enables both tangible and intangible heritage to be documented, archived, interpreted, and disseminated through websites, social media, digital libraries, virtual museums, digital storytelling, virtual reality, and other multimedia platforms. These technologies provide new opportunities for communities to participate in the preservation and transmission of cultural heritage while simultaneously expanding cultural accessibility beyond local and national boundaries. UNESCO (2022) emphasizes that digital transformation can strengthen the documentation, conservation, safeguarding, interpretation, promotion, and management of cultural heritage. Digital technologies can therefore facilitate the transmission of cultural knowledge to younger generations and allow cultural heritage to remain a living component of contemporary society rather than merely an artifact of the past.[8] UNESCO further emphasizes that digital technologies can expand access to culture while stimulating creativity and innovation, although such opportunities require appropriate governance and equitable access to digital infrastructure and skills.[9]

The development of Indonesia's digital society has a gradual improvement over the 2023–2025 period, although progress has varied substantially across the different dimensions of digital development. The Indonesia Digital Society Index **(**IMDI**)** is an important national instrument for assessing the development and readiness of Indonesia's digital society. The index measures four major dimensions**:** Infrastructure and Ecosystem, Digital Skills/Digital Literacy, Empowerment, and Employment**.** The measurement is conducted across Indonesia's in 38 provinces and 514 regencies/cities, providing a geographically comprehensive picture of the development of the digital society. The Ministry of Communication and Digital Affairs explains that IMDI is designed to support evidence-based policymaking and the development of Indonesia's digital human resources.

Table 1.

Development of the Indonesia Digital Society Index by Pillar, 2023–2025

| Instrument Measure | 2023 | 2024 | 2025 | Development Pattern |
|---|---|---|---|---|
| **Infrastructure and Ecosystem** | 57.09 | 52.70 | 53.06 | Declined in 2024, followed by a slight recovery in 2025 |
| **Digital Skills / Digital** | 56.59 | 58.25 | 49.28 | Increased in 2024 but declined substantially in |

[6] Fukuyama, M. (2018). Society 5.0: Aiming for a new human-centered society.
[7] Castells, M. (2010). *The rise of the network society* (2nd ed.).
[8] UNESCO. (2022). *The digital transformation and the cultural sector*. UNESCO
[9] OpCit UNESCO (2022)

| Instrument Measure | 2023 | 2024 | 2025 | Development Pattern |
|---|---|---|---|---|
| **Literacy** | | | | 2025 |
| **Empowerment** | 26.19 | 25.66 | 34.32 | Slight decline in 2024, followed by substantial growth in 2025 |
| **Employment** | 32.14 | 38.09 | 42.91 | Consistent and substantial increase |
| **National IMDI** | **43.18** | **43.34** | **44.53** | Overall gradual increase |

Source: Ministry of Communication and Digital Affairs of the Republic of Indonesia (Komdigi), *Indonesia Digital Society Index (IMDI) 2025*.

The data in Table 1 reveal several important characteristics of Indonesia's digital transformation. The Infrastructure and Ecosystem pillar decreased from 57.09 in 2023 to 52.70 in 2024, before increasing slightly to 53.06 in 2025. Although the 2025 score indicates a modest recovery, it remained below the 2023 level. This pattern suggests that the development of digital infrastructure and the broader digital ecosystem has not progressed uniformly during the period. Nevertheless, infrastructure remains the strongest pillar of the 2025 IMDI, with a score of 53.06. The official 2025 report identifies infrastructure and ecosystem as the highest-scoring component of the national index.

The Digital Skills/Digital Literacy pillar presents a particularly important pattern for the present study. Its score increased from 56.59 in 2023 to 58.25 in 2024, but declined considerably to 49.28 in 2025. The 2024 increase had previously indicated an improvement in digital competencies, as reported by BPSDM Komdigi. However, the substantial decline recorded in 2025 indicates that the expansion of digital access does not necessarily correspond to an equivalent strengthening of digital competencies. This finding is particularly relevant because digital literacy constitutes an essential human dimension of digital transformation. The ability to access digital technologies must be accompanied by capacity to critically evaluate information, communicate responsibly, create digital content, and participate constructively in digital environments.

Table 2.

National Indonesia Digital Society Index, 2023–2025

| Year | National IMDI Score | Annual Change | Development |
|---|---|---|---|
| **2023** | 43.18 | — | Baseline |
| **2024** | 43.34 | +0.16 | Slight increase |
| **2025** | 44.53 | +1.19 | More substantial increase |

Source: Ministry of Communication and Digital Affairs of the Republic of Indonesia (Komdigi), *Indonesia Digital Society Index (IMDI) 2025*.

As shown in Table 2, Indonesia's national IMDI increased from 43.18 in 2023 to 43.34 in 2024**,** representing a relatively modest increase of 0.16 points. The index subsequently increased to 44.53 in 2025**,** representing an annual increase of 1.19 points. The Ministry of Communication and Digital Affairs confirms that the 2025 score of 44.53 represents a 1.19-point increase compared with 2024. The 2025 measurement involved more than 18,000 individual respondents and 11,000 industry respondents and covered 38 provinces and 514 regencies/cities.

The overall increase in the national IMDI indicates that Indonesia's digital society has continued to develop. However, the relatively moderate level of the overall index and the uneven development among its four pillars demonstrate that digital transformation remains a multidimensional and incomplete process. In particular, the difference between the relatively strong Infrastructure and Ecosystem score and the substantially lower Empowerment score suggests that access to digital technologies does not automatically translate into meaningful social and economic utilization. The 2025 IMDI report explicitly notes that although digital infrastructure and ecosystems are relatively

adequate, their utilization for productive activities remains suboptimal, particularly in relation to economic improvement.

This development provides an important the relationship between digital literacy and cultural digitalization**.** In cultural heritage, digital platforms provide opportunities to document, preserve, disseminate, and reinterpret local cultural values. However, the effectiveness of cultural digitalization depends on the ability of individuals and communities to critically engage with digital content. Without adequate digital literacy, digital cultural content may be vulnerable to misinterpretation, distortion, commodification, misinformation, or inappropriate representation. Conversely, stronger digital literacy may enable communities to use digital platforms to preserve cultural identity, promote intercultural dialogue, strengthen social participation, and disseminate values associated with peaceful coexistence.

The national IMDI trend also provides a relevant foundation for understanding digital peacebuilding and regional resilience**.** Digital platforms can function as spaces for cultural expression, social interaction, dialogue, and community participation. Nevertheless, these same platforms may also facilitate polarization, misinformation, hate speech, and identity-based tensions. Therefore, digital infrastructure alone is insufficient to guarantee a resilient digital society. Digital resilience requires the interaction of infrastructure, human capabilities, empowerment, and productive utilization.

This issue is particularly relevant to Central Java, where cultural heritage. The 2025 IMDI data show that Central Java recorded an IMDI score of 51.19, considerably above the national average of 44.53. Central Java was also identified, together with Yogyakarta and Bali, as one of the major cultural regions that exceeded the national digital society index. This condition makes Central Java an especially relevant empirical setting for examining whether a relatively strong digital ecosystem can support the digitalization of Javanese cultural heritage and contribute to peacebuilding and regional resilience.

Nevertheless, cultural digitalization presents a fundamental paradox. Digital platforms provide local communities with unprecedented opportunities to represent their cultural identities, promote traditional practices, and reach audiences beyond their immediate geographical environments. Digitalization can consequently strengthen cultural visibility, community participation, and intergenerational transmission. The digital environment may also contribute to the simplification, commodification, distortion, and homogenization of cultural expressions. Digital platforms are governed by algorithms that influence which become visible and widely circulated, while unequal access to digital infrastructure, technological resources, and digital competencies may create disparities in the ability of communities to represent their cultural identities.[10]Highlights that digital transformation in the cultural sector generates important challenges concerning cultural and linguistic diversity, unequal access, intellectual property, cultural data governance, and the production, distribution, and consumption of cultural expressions. More recent UNESCO analysis further emphasizes that the digitalization of cultural heritage needs to be accompanied by appropriate governance, ethical safeguards, and attention to cultural data sovereignty, particularly of emerging technologies such as artificial intelligence.

These challenges are particularly significant in Indonesia, most culturally diverse countries. Indonesia's cultural landscape is characterized by extensive ethnic, linguistic, traditional, and cultural diversity distributed across its many islands. The *Long Form Population Census 2020* published by Statistics Indonesia (BPS, 2024)[11] documents substantial ethnic and regional-language diversity and provides information on the socio-demographic characteristics of ethnic groups as well as the languages used within families and communities. Such diversity represents an important social and cultural resource for national development because cultural identities, traditions, and local knowledge can contribute to social cohesion and collective identity. However, the rapid transformation of

[10] OpCit UNESCO (2022)

[11] Badan Pusat Statistik. (2024). *Profil suku dan keragaman bahasa daerah hasil Long Form Sensus Penduduk 2020*

communication patterns and the growing dominance of digital media also require adaptive strategies to ensure that cultural diversity is not weakened by technological change. The challenge is therefore not simply how to preserve cultural heritage, but how to transform and transmit cultural values in ways that remain meaningful within an increasingly digital society.

Within this broader Indonesian, central java provides a particularly relevant setting for examining the relationship between cultural digitalization, peacebuilding, and regional resilience**.** Javanese culture encompasses a broad range of tangible and intangible cultural expressions, including *wayang*, *gamelan*, traditional dance, batik, performing arts, local knowledge, and oral traditions. Beyond artistic expressions, javanese cultural heritage also incorporates social values associated with harmonious social relations, including mutual cooperation, consideration and respect for others, deliberation, social balance, mutual respect, and the peaceful management of differences. These values can potentially function as social and cultural resources for strengthening social cohesion and peacebuilding when they are appropriately adapted to contemporary digital environments.

The importance of preserving these social and cultural values has also been formally recognized within the policy framework of central java. *Governor Regulation of Central Java Province No. 32 of 2016 on Guidelines for the Preservation and Development of Customs and Community Social-Cultural Values* recognizes customs and social-cultural values as important resources for community development. The regulation also identifies globalization and advances in information and communication technology as challenges that may threaten the continuity of local customs and social-cultural values. Consequently, the regulation emphasizes the preservation and development of social-cultural values as a means of strengthening identity, dignity, social pride, unity, and social cohesion within central java.[12]

The intersection between cultural heritage and digital transformation therefore creates an important opportunity to reconceptualize culture as a resource for peacebuilding. Traditionally, cultural heritage has often been approached primarily from the perspective of preservation, identity, tourism, or creative industries. However, culture can also serve as a mechanism for strengthening relationships between individuals and social groups. Values embedded in cultural practices can provide normative foundations for mutual respect, dialogue, cooperation, tolerance, and peaceful coexistence. When these values are digitally documented, communicated, and reproduced, digital platforms may provide new spaces through which cultural narratives can contribute to social cohesion. From this perspective, digital culturalization should not be limited to the preservation of cultural artifacts but should also encompass the transformation of cultural knowledge and values into resources for constructive social interaction.

The rapid expansion of digital technologies has fundamentally transformed the ways in which individuals and communities communicate, construct identities, negotiate differences, and reproduce cultural values. Digital platforms have created new spaces for interaction that extend beyond geographical boundaries, enabling communities to preserve cultural expressions, exchange knowledge, participate in public discourse, and establish new forms of social connection. However, digital transformation does not automatically produce social cohesion. Digital spaces may simultaneously facilitate misinformation, polarization, stereotyping, exclusion, and identity-based tensions. Consequently, the relationship between digitalization, culture, and peacebuilding requires an approach that considers not only technological access but also the quality of participation, digital literacy, cultural identity, and the capacity of communities to manage differences constructively.

Recent research digital transformation can have significant implications for the sustainability of peace cultures. Ahnaf, et. al. (2023), digital transformation and social media communication can alter the social spaces through which communities reproduce peaceful cultural practices. Their study of religious communities in Yogyakarta that changes in patterns of social interaction may weaken that previously supported social cohesion and the reproduction of peace culture. This finding is

[12] Governor Regulation of Central Java Province No. 32 of 2016 on guidelines for the preservation and development of customs and community social-cultural values.

particularly relevant to the Indonesian because it digitalization is not merely a technological process but also a process of social and cultural transformation that can influence the resilience of peaceful relationships within communities.[13]

Digital technologies can be used constructively to strengthen cultural participation and social cohesion. Pescarin, et. al. (2023) interactive digital heritage experiences can contribute to social cohesion when they incorporate collaborative activities, mediated dialogue, trust, inclusion, and opportunities for meaningful interaction.[14] Their empirical study indicates that digital heritage should not be understood simply as the conversion of cultural materials into digital formats. Rather, digital heritage can become a social environment in which individuals collectively engage with cultural memory and develop stronger connections with other members of society. This perspective is highly relevant to Javanese cultural digitalization because the digital representation of wayang, gamelan, batik, traditional ceremonies, oral traditions, and other cultural practices can potentially become an instrument for strengthening cultural belonging and social interaction.

The relationship between cultural heritage and social cohesion is also quantitative evidence. Li, et. al. (2024), using an urban survey in Nara, Japan, found a positive relationship between cultural heritage and social cohesion. Their findings indicate that heritage awareness and patterns of heritage use are closely associated with social cohesion, suggesting that cultural heritage can function as a social resource rather than merely as an object of preservation.[15] This finding provides an important theoretical basis for conceptualizing Javanese cultural digitalization as an antecedent of social cohesion and peacebuilding. When cultural knowledge becomes accessible through digital platforms, communities may gain additional opportunities to recognize shared cultural values, strengthen collective identity, and develop connections across social groups.

Nisi, et. al. (2023) digital cultural heritage tools and digital storytelling can create spaces for social inclusion and cohesion by encouraging participatory engagement among communities with different social and cultural backgrounds.[16] Their study emphasizes the potential of digital interventions to create connections among groups that may otherwise remain socially separated. Zhang, et. al. (2024) digitalization has transformed cultural heritage management by creating opportunities for greater youth participation.[17] Their framework emphasizes digital citizenship, critical awareness, and active participation as important dimensions of meaningful engagement with cultural heritage in digital environments.

These findings suggest that Javanese Cultural Digitalization should be conceptualized more broadly than the simple digitization or online promotion of cultural artifacts. Cultural digitalization can be understood as a multidimensional process involving the documentation, preservation, dissemination, participation, reinterpretation, and transmission of Javanese cultural knowledge and values through digital technologies. Such a process can facilitate the intergenerational transmission of cultural values while simultaneously creating new spaces for dialogue and participation. Values associated with Javanese social life, deliberation, mutual respect, tolerance, and social harmony, can therefore be represented and communicated through digital media as resources for constructive interaction and peacebuilding.

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[13] Ahnaf, M. I., Yulianti, Pattiserlihun, S. C., & Ahda, M. N. F. (2023). Digital transformation, social change and the challenge of peaceful cultural reproduction of religious communities in Yogyakarta. *Jurnal Masyarakat dan Budaya*

[14] Pescarin, S., Bonanno, V., & Marasco, A. (2023). Social cohesion in interactive digital heritage experiences. *Multimodal Technologies and Interaction*

[15] Li, H., Ikebe, K., Kinoshita, T., Chen, J., Su, D., & Xie, J. (2024). How heritage promotes social cohesion: An urban survey from Nara city, Japan.

[16] Nisi, V., Bala, P., Cesário, V., James, S., Del Bue, A., & Jardim Nunes, N. (2023). "Connected to the people": Social inclusion & cohesion in action through a cultural heritage digital tool. *Proceedings of the ACM on Human-Computer Interaction*

[17] Zhang, Y., Ikiz Kaya, D., & van Wesemael, P. (2024). An assessment framework for digital participatory practices engaging youth in cultural heritage management. *Journal of Cultural Heritage*

Cultural digitalization alone may not guarantee peaceful outcomes. The ability of individuals to interpret, evaluate, and communicate cultural information critically is equally important. This is where Digital Literacy becomes a crucial explanatory variable. Digital literacy involves more than the technical ability to operate digital devices. It encompasses the capacity to access, evaluate, interpret, produce, and communicate information responsibly and critically within digital environments. In the context of peacebuilding, digital literacy becomes particularly important because individuals encounter competing narratives, misinformation, emotionally charged content, and identity based representations through social media and other digital platforms.

Wei, et. al. (2023) social media literacy can influence the relationship between individual decision making factors and fake news sharing behavior, highlighting the importance of users' ability to critically evaluate information in digital environments.[18] Guriev, et. al. (2023), through a randomized experiment, demonstrated that interventions aimed at improving people's ability to distinguish accurate from inaccurate information can influence their capacity to recognize misinformation, although the effectiveness of interventions depends on their design and the provision of personalized feedback.[19] These findings indicate that digital literacy is not merely a technical competency but an important cognitive and social capacity for navigating contested information environments.

Digital literacy is therefore important because it can strengthen individuals' capacity to distinguish between constructive cultural communication and information that may generate misunderstanding or conflict. A digitally literate individual is more capable of questioning misleading narratives, recognizing manipulative content, understanding different perspectives, and communicating cultural differences responsibly. Consequently, digital literacy may function as an enabling condition through which cultural digitalization contributes to social cohesion rather than polarization. Hirblinger (2023) digital technologies can shape peacebuilding not only through the provision of information and evidence but also through new forms of interaction and the construction of alternative possibilities for peace.[20] Digital technologies therefore create both opportunities and challenges for peacebuilding, depending on how they are designed and used.

Ahnaf, et al. (2023) show that digital transformation can challenge established mechanisms of peaceful cultural reproduction, particularly when digital communication reduces opportunities for direct interpersonal interaction.[21] The findings of Pescarin, et. al. (2023), Nisi, et. al. (2023), and Zhang, et. al. (2024) digital technologies can also be intentionally designed to promote cultural participation, inclusion, dialogue, and social cohesion. This contrast suggests that the impact of digitalization depends substantially on how digital technologies are embedded within cultural and social processes.

Regional resilience can be positioned as an important outcome of peacebuilding. Regional resilience refers to the capacity of communities and institutions to anticipate, withstand, adapt to, and recover from social, economic, political, cultural, environmental, and technological disruptions. From a sociocultural perspective, resilience is not determined solely by material resources or institutional capacity. Social trust, collective identity, community participation, networks of cooperation, cultural belonging, and the ability to manage differences are also important resources that enable communities to respond to disruption.

This theoretical relationship is consistent with recent evidence showing that digital communication technologies can contribute to social cohesion when they facilitate meaningful social connections. A systematic review by Üblacker, et. al. (2024) emphasizes that digital information and

[18] Wei, L., Gong, J., Xu, J., Zainal Abidin, N. E., & Apuke, O. D. (2023). Do social media literacy skills help in combating fake news spread? Modelling the moderating role of social media literacy skills in the relationship between rational choice factors and fake news sharing behaviour. *Telematics and Informatics*

[19] Guriev, S., Melnikov, N., & Treisman, D. (2023). Countering misinformation on social media through educational interventions: Evidence from a randomized experiment in Pakistan. *Journal of Development Economics*

[20] Hirblinger, A. T. (2023). Building a peace we don't know? The power of subjunctive technologies in digital peacebuilding. *Peacebuilding*

[21] Op.Cit

communication technologies can function as catalysts of social connection and neighborhood cohesion, although their effects depend on how technologies interact with existing social structures.[22]

In addition, direct relationships between Javanese Cultural Digitalization and Regional Resilience and between Digital Literacy and Regional Resilience can be examined. It also moves beyond approaches that treat cultural digitalization merely as a preservation or tourism strategy by positioning digital culturalization as a potential mechanism for peacebuilding and resilience.

For Central Java, this framework is particularly relevant because Javanese cultural heritage is deeply embedded in social identity and community life. The digitalization of Javanese cultural knowledge can potentially expand access to cultural resources among younger generations while creating new opportunities for participation and dialogue. However, the effectiveness of initiatives depends on whether digital users possess sufficient literacy to interpret cultural information critically and whether digital platforms are designed to promote constructive interaction rather than polarization. Therefore, examining Javanese Cultural Digitalization, Digital Literacy, and Regional Resilience within a single quantitative model can provide a more comprehensive understanding of the relationship between cultural transformation and peacebuilding in the digital era.

## LITERATURE REVIEW

### Regional Resilience in National Development and Distruption

Regional resilience has increasingly emerged as an important conceptual framework for understanding how regions, communities, and institutions respond to various forms of disruption, including economic, social, political, environmental, technological, and public-health crises. Contemporary scholarship has moved beyond the traditional interpretation of resilience as the capacity of a system to simply return to its previous condition following a crisis. Instead, resilience is increasingly understood as a dynamic and multidimensional capacity that enables regional systems to absorb disturbances, adapt to changing circumstances, reorganize resources, maintain essential functions, learn from previous experiences, and potentially transform themselves in response to emerging challenges. Resilient region is not merely one that survives a crisis, but one that is capable of learning, adapting, reorganizing, and developing new capacities to address future uncertainties. Turgel & Chernova (2024) through their bibliometric analysis that regional resilience research has expanded considerably following major global disruptions, particularly the COVID-19 pandemic, with increasing attention to the structural and relational characteristics that enable regions to reorganize resources and strengthen their adaptive capacity.[23]

This contemporary understanding indicates that regional resilience cannot be reduced to economic performance or the availability of physical infrastructure alone. Rather, resilience emerges from the interaction of economic, institutional, social, cultural, environmental, and technological capacities. A region may possess strong economic resources and advanced infrastructure but remain vulnerable if its communities experience social fragmentation, institutional distrust, cultural marginalization, inequality, or limited participation in decision-making processes. Conversely, communities with relatively limited material resources may substantial resilience when they possess strong social networks, cultural identity, collective solidarity, effective institutions, and

[22] Üblacker, J., Liebig, S., & Hamad, H. (2024). Catalysts of connection: The role of digital information and communication technology in fostering neighbourhood social cohesion: A systematic review of empirical findings. *Urban Studies*

[23] Turgel, I. D., & Chernova, O. A. (2024). COVID-19 and regional resilience: Trends, priorities, and the geography of research. *Journal of Safety Science and Resilience*

the ability to mobilize available resources. Polain de Waroux (2024) emphasizes that resilience has become an increasingly influential concept for understanding complex social and environmental challenges; however, its empirical operationalization requires careful attention to the interactions among multiple dimensions of a system.[24] resilience should not be treated as a single and static attribute but as a multidimensional process involving the capacity of individuals, communities, and institutions to navigate disruptions while maintaining and improving collective well-being.

The multidimensional nature of resilience is also reflected in the broader literature on community resilience. Recent systematic research indicates that resilience commonly incorporates social, economic, physical, institutional, and community-capital dimensions. Education, income, health capacity, social networks, community resources, and institutional support are among the factors frequently associated with the capacity of communities to cope with disruption. Such findings reinforce the argument that regional resilience is determined not only by material resources but also by the quality of social relationships, the availability of community resources, and the capacity of people to mobilize these resources collectively. Therefore, regional resilience can be conceptualized as an integrated outcome of material and non-material resources. Social capital, trust, solidarity, cultural knowledge, collective identity, institutional capacity, and community networks constitute strategic resources that can strengthen a region's capacity to respond to uncertainty and crisis.

The multidimensional character of resilience also implies that regional development should not be evaluated solely contribution to economic growth. Development should also be assessed capacity to enhance the adaptive capabilities of communities and institutions. Development can strengthen resilience when it improves infrastructure, public services, education, employment opportunities, institutional capacity, social networks, access to information, and technological capabilities. However, development does not automatically generate resilience when economic progress is accompanied by inequality, social exclusion, weakened cultural identity, environmental degradation, or limited community participation. Regional development therefore needs to be understood as a process of building the capacities required by communities to cope with uncertainty, manage differences, respond to crises, and adapt to structural change. In this regard, regional resilience provides an analytical bridge between development and the capacity of regional societies to withstand, adapt to, and transform in response to disruption.

The relationship between resilience and social-cultural capacity becomes particularly important in culturally diverse regions. Cultural values, collective identity, social norms, solidarity, mutual assistance, and locally embedded mechanisms for resolving disputes constitute non-material resources that can support community resilience. Cultural systems can provide individuals with a sense of belonging, continuity, meaning, and collective responsibility during periods of rapid social transformation. Digital platforms can facilitate the documentation, dissemination, education, and intergenerational transmission of cultural heritage, while also creating new spaces for social interaction and collective participation.

The socio-ecological perspective of resilience developed by Ungar (2008) conceptualizes resilience not simply as an individual psychological trait but as a dynamic process emerging from the interaction between individuals and their social, cultural, and ecological environments.[25] From this perspective, resilience involves the ability to navigate toward resources that sustain well-being

[24] Polain de Waroux, Y. L. (2024). How do we study resilience? A systematic review. *People and Nature*.
[25] Ungar, M. (2008). Resilience across cultures. *The British Journal of Social Work*

and to negotiate access to these resources in culturally meaningful ways. This approach is particularly relevant to regional resilience because the capacity of communities to respond to disruption depends not only on their internal characteristics but also on whether their surrounding environments provide accessible, meaningful, equitable, and culturally appropriate resources.

Ungar, et. al. (2007). Their findings emphasize that there is no universal configuration of resilience that applies identically to every population. Instead, resilience is shaped by the interaction between individuals, communities, cultural expectations, available resources, and institutional environments.[26]

Based on Ungar's (2008) theoretical framework, the present study conceptualizes regional resilience through seven interrelated dimensions: **access to material resources, relationships, identity, power and control, cultural adherence, social justice, and cohesion**. These aspect are not treated as independent and isolated characteristics. Rather, they represent interconnected pathways through which individuals and communities navigate and negotiate resources, opportunities, social relationships, cultural meanings, and institutional conditions in order to maintain well-being and respond effectively to adversity.

**Javanese Cultural Digitalization and Cotemporary Development**

Cultural digitalization has emerged as an important phenomenon in contemporary society as digital technologies become increasingly embedded in various dimensions of social life. The growing use of the internet, social media, digital platforms, multimedia technologies, and computational systems has fundamentally transformed the ways in which culture is documented, represented, produced, transmitted, accessed, interpreted, and reproduced. Consequently, cultural digitalization should not be understood merely as a technical process of converting cultural artifacts or documents from analog into digital formats. Rather, it represents a broader process of cultural transformation that affects cultural practices, patterns of participation, identity formation, knowledge reproduction, and the construction and negotiation of meaning within society.

Manovich's (2001) concept of *new media*. Digitalization as a process through which media are transformed into computational data that can be processed, manipulated, reproduced, and distributed through computers and software. From this perspective, digitalization is not simply a change in format from analog to digital; rather, it represents a structural transformation that influences how cultural objects are produced, represented, stored, modified, distributed, and consumed.[27] Texts, images, sounds, videos, films, and visual spaces can be translated into numerical data and subsequently processed through computational systems. As a result, cultural objects become *computable*, meaning that they can be manipulated, combined, reproduced, and circulated through digital environments.

These characteristics digitalization fundamentally changes the logic of cultural production and circulation. A cultural object in a digital environment is no longer necessarily static or fixed. It can be edited, remixed, recontextualized, reproduced, and distributed across multiple platforms. for example, traditional performing arts, batik, wayang, gamelan, Javanese language, literature, folklore, rituals, traditional knowledge, and other cultural expressions can be converted into digital

[26] Op.Cit
[27] Manovich, L. (2001). *The language of new media*. MIT Press.

forms and subsequently reproduced through websites, digital archives, social media, streaming platforms, educational applications, and interactive media.

The digitalization of cultural objects alone does not necessarily constitute cultural transformation. The significance of digitalization lies in the ways in which digital technologies alter the relationships between cultural objects, cultural producers, cultural institutions, and audiences. A recording of a traditional Javanese performance, for instance, represents an initial stage of digitization. When the recording is subsequently edited, contextualized, distributed through digital platforms, discussed by online communities, incorporated into educational materials, and reinterpreted by younger generations, the process moves beyond simple digitization toward a broader process of cultural digitalization. Digitalization therefore involves not only the conversion of cultural materials into digital formats but also the transformation of the social processes through which culture is produced, communicated, consumed, and reproduced.

Hjarvard (2014) provides an important sociological and institutional perspective through the concept of mediatization. Hjarvard media have become increasingly integrated into social life and are no longer merely channels for transmitting information.[28] Instead, media have increasingly developed into social institutions with their own forms of logic, practices, and mechanisms that influence social interaction and cultural processes. This perspective is particularly relevant to cultural digitalization because digital media do not simply transmit cultural content; they also influence how cultural realities are constructed, represented, distributed, and interpreted.

The characteristics of cultural content that is visually attractive, concise, interactive, emotionally engaging, and easily shareable may receive greater visibility within digital platforms. Consequently, culture is not simply transferred into digital environments; it is also adapted to the technological and communicative logic of those environments. This process that cultural digitalization is not culturally neutral. When cultural expressions enter digital platforms, their forms of representation, modes of communication, and patterns of audience interaction may change. A traditional Javanese performance, may be presented differently on social media than in a traditional community setting.

This perspective can be further extended through Deuze's (2006) conceptualization of digital culture as a set of social practices and values that emerge through continuous interaction between people and digital media. Digital culture should not be understood simply as an outcome of technological development; rather, it has become an integral component of everyday social life. Digital technologies are increasingly embedded in communication, education, work, information seeking, social networking, entertainment, and identity expression.[29]

The increasingly blurred distinction between media producers and consumers. Individuals are no longer merely passive recipients of cultural information but can simultaneously become producers, distributors, commentators, and interpreters of cultural content. The development of social media and user-generated content platforms has expanded opportunities for individuals and communities to create and circulate cultural expressions independently. Cultural digitalization and community participation. Digitalization provides opportunities for communities to become not only objects of cultural preservation but also active subjects in the production and reproduction of culture. Javanese culture, younger generations can play an important role in reinterpreting cultural values and

[28] Hjarvard, S. (2014). Mediatization and cultural and social change: An institutional perspective. In K. Lundby (Ed.), *Mediatization of communication*

[29] Deuze, M. (2006). Participation, remediation, bricolage: Considering principal components of a digital culture. *The Information Society*

practices through digital formats that are compatible with their everyday communication environments social harmony, and respect for diversity can be communicated through short-form videos, podcasts, animation, digital storytelling, online discussions, and digital communities. Through such processes, traditional cultural values can acquire new forms of communication while maintaining their relevance to contemporary social life.

Pescarin, et. al. (2023) interactive digital heritage experiences can contribute to social cohesion by creating opportunities for communities to interact and engage with cultural heritage. This finding indicates that digital technologies in cultural serve functions beyond preservation and documentation; they can also facilitate social interaction and collective engagement. Digital cultural heritage can therefore become a social resource through which communities establish connections and develop shared experiences.[30]

These challenges indicate that technological access alone is insufficient. Communities require the capacity to critically understand, evaluate, produce, and distribute digital cultural content. Digital literacy becomes an important complementary factor in the process of cultural digitalization. Digital literacy enables individuals and communities not only to access digital technologies but also to critically evaluate how information is produced, represented, distributed, and consumed within digital environments. Individuals with stronger digital literacy are better positioned to assess the credibility of cultural information, identify misinformation, understand cultural contexts, recognize potentially distorted representations, and produce responsible digital content. Cultural digitalization and digital literacy can therefore be viewed as mutually reinforcing processes. Digitalization provides the technological infrastructure and communicative spaces for cultural participation, while digital literacy provides the capacity to use those spaces critically, creatively, inclusively, and responsibly.

Furthermore, Javanese cultural digitalization can be connected to the emerging concept of digital peacebuilding. Cultural values such as deliberation, respect for differences, tolerance, and social harmony can function as cultural resources for peacebuilding. When these values are represented and communicated through inclusive digital environments, culture can contribute to dialogue, mutual understanding, and constructive intergroup interaction. From this perspective, cultural digitalization is not only a mechanism for preserving the past but can also become a strategic resource for strengthening peaceful social relations in contemporary society.

The present study adopts the aspect derived primarily from Manovich's (2001) theory of *new media* is **Numerical Representation, Modularity, Automation, Variability, and Transcoding, and Social Justice Interface.**

**Digital Literacy**

Digital literacy enables individuals and communities not only to access digital technologies but also to understand how information is produced, evaluated, disseminated, and consumed within digital environments. Individuals with higher levels of digital literacy are better equipped to evaluate the credibility of cultural information, distinguish accurate information from misleading or false information, understand cultural contexts, and produce digital content in a responsible manner. Therefore, digital culturalization and digital literacy can be understood as complementary processes.

[30] Pescarin, S., Bonanno, V., & Marasco, A. (2023). Social cohesion in interactive digital heritage experiences. *Multimodal Technologies and Interaction*

Digitalization provides the infrastructure and digital spaces through which cultural participation can take place, whereas digital literacy provides individuals and communities with the capacity to use those spaces critically, productively, inclusively, and responsibly.

Javanese cultural digitalization should therefore not be understood merely as the digitization of cultural artifacts, but as a broader process involving the preservation, representation, accessibility, production, participation, distribution, transmission, and reinterpretation of Javanese culture through digital technologies. The distinction between artifact digitization and cultural digitalization is conceptually important. When a collection of batik textiles, for example, is simply scanned and stored in a digital database, the process primarily represents digitization in a technical sense. However, when the same collection is incorporated into cultural education, promoted through digital platforms, transformed into interactive content, discussed by cultural communities, and used by younger generations to develop new cultural innovations, the process represents cultural digitalization in a more substantive sense. In this broader perspective, digitalization transforms cultural heritage from a static object of preservation into a dynamic resource for participation, learning, communication, and cultural reproduction.

Javanese cultural digitalization can further be connected to digital peacebuilding. Cultural values such as deliberative discussion, respect for differences, social harmony, mutual assistance, and peaceful coexistence can provide important normative resources for peacebuilding. When these values are represented, communicated, and discussed through inclusive digital spaces, culture can function as a social catalyst for strengthening dialogue, mutual understanding, and positive intergroup relationships. Digital culturalization can therefore serve not merely to preserve the past but also to construct constructive social relationships in the present and future.

Hirblinger, et. al. (2023) emphasize that digital technologies have significant potential for peacebuilding, particularly by creating opportunities for participation, communication, knowledge exchange, and engagement. However, they also argue for a critical and reflexive approach because digital environments can simultaneously reproduce exclusion, inequalities, misinformation, polarization, and conflict. Digital spaces are therefore not inherently peaceful or conflictual; their effects depend substantially on how technologies are designed, accessed, interpreted, and used by different actors.[31] This perspective is highly relevant to cultural digitalization because the representation of cultural heritage online may contribute to dialogue and social cohesion when it is inclusive and contextualized, but may also generate misunderstanding or conflict when cultural information is distorted, decontextualized, or manipulated.

Bawden (2001) positioned digital literacy as a conceptual development of information literacy an increasingly technology and network-based society. Digital literacy, extends beyond the technical ability to operate computers and includes cognitive capacities to understand, evaluate, and use information presented in multiple digital formats.[32] The contemporary development of digital literacy research reinforces this broader understanding. Peng, et. al. (2022), through a literature review examining the development of digital literacy concepts over two decades, identified two broad orientations in the literature: one emphasizing technical skills and another emphasizing the ability to understand, process, and meaningfully use information. Their findings indicate that digital literacy cannot be reduced to the ability to operate digital devices because the interpretation and

[31] Hirblinger, A. T., Hansen, J. M., Hoelscher, K., Kolås, Å., Lidén, K., & Martins, B. O. (2023). Digital peacebuilding: A framework for critical–reflexive engagement. *International Studies Perspectives*

[32] Bawden, D. (2001). Information and digital literacies: A review of concepts. *Journal of Documentation*

meaningful use of information are fundamental components of digital literacy.[33]

Tinmaz, et. al. (2022), through a systematic review of the digital literacy literature, identified four major themes: digital literacy, digital competencies, digital skills, and digital thinking. These themes digital literacy is a multidimensional construct encompassing technological skills, information management, digital competencies, and critical and analytical thinking. Digital literacy in contemporary society should consequently be understood as the capacity to use digital technologies and information in ways that are not only technically effective but also critical, productive, creative, and responsible.[34]

The multidimensional character of digital literacy is critical digital literacies. Ilomäki et al. (2023), based on a systematic review, digital literacy is associated with several dimensions, including digital safety, digital participation and presence, media literacy, digital citizenship, technological literacy, information literacy, data literacy, creativity and digital innovation, and digital well-being. This perspective indicates that digital literacy is not simply an individual technical competence but also involves the capacity to participate safely, critically, ethically, and constructively in increasingly digitalized social environments.[35]

This issue has become increasingly important as digital environments are confronted with misinformation, disinformation, fake news, manipulated information, deepfakes, and AI-generated content. In such an environment, individuals require more than basic technological skills. They need the ability to question sources, cross-check information, recognize misleading narratives, identify potential bias, and critically assess the credibility and accuracy of digital content. Digital literacy can therefore function as an important cognitive and social capacity for navigating the complexity of contemporary information ecosystems.

Bawden's (2001) conceptualization of digital literacy is particularly relevant to this study because contemporary digital environments enable individuals and communities to access vast amounts of information from diverse sources, formats, and digital platforms[36]. Under these conditions, the ability to operate digital technologies alone is insufficient to ensure that information can be accessed, understood, evaluated, and used appropriately. Individuals must also be able to understand the structure of digital information, assess the credibility and relevance of information sources, connect and integrate information from multiple sources, and consider the ethical implications of producing, using, and disseminating information. Present study adapts aspects of digital literacy that are particularly relevant to the contemporary digital information environment: **basic skills as the foundation of digital literacy, evaluative ability and critical thinking, navigation within hypertext structures, knowledge assembly, and attitudes, values, and ethical awareness in the use of information.**

In the previous literature, the alternate research hypotheses

**H1:** Javanese cultural digitalization has a significant effect on regional resilience.

**H2:** Digital literacy has a significant effect on regional resilience.

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[33] Peng, D., et al. (2022). A literature review of digital literacy over two decades. *Education Research International*

[34] Tinmaz, H., Lee, Y.-T., Fanea-Ivanovici, M., & Baber, H. (2022). A systematic review on digital literacy. *Smart Learning Environments*

[35] Ilomäki, L., Paavola, S., Lakkala, M., & Kallunki, V. (2023). Critical digital literacies at school level: A systematic review. *Review of Education*

[36] Bawden, D. (2001). Information and digital literacies: A review of concepts. *Journal of Documentation*

## METHODOLOGY RESEARCH

This study employed a quantitative research approach to examine the relationships among the variables and to provide empirical evidence for answering the research questions. A quantitative approach is appropriate when a study seeks to operationalize theoretical concepts into measurable variables and statistically examine the relationships among those variables (Creswell & Creswell, 2018). In this study, the quantitative approach was used to measure the effects of Javanese cultural digitalization and digital literacy on regional resilience through standardized measurements administered to respondents.[37]

The research adopted a cross-sectional research design, in which data were collected from respondents at a particular period using a structured questionnaire. Cross-sectional designs are commonly used in quantitative social research because they enable researchers to examine relationships among variables based on data collected from a defined population within a specified period (Creswell & Creswell, 2018). Although cross-sectional research is useful for identifying statistical associations and testing theoretically derived relationships, the interpretation of causal relationships should remain theoretically grounded because measurements are obtained at a single point or period of observation.[38]

Data were collected using a structured questionnaire with a five-point Likert scale. The response categories ranged from 1 = strongly disagree to 5 = strongly agree, allowing respondents to indicate the degree to which they agreed with each statement representing the research constructs. Likert-type scales are widely used in behavioral and social science research because they provide a systematic approach for measuring perceptions, attitudes, and other latent constructs (Boone & Boone, 2012). In the present study, the questionnaire items were developed to operationalize the constructs of Javanese cultural digitalization, digital literacy, and regional resilience.[39]

The research was conducted over an 8$^{th}$period, from December 2025 to August 2026. The research period covered several stages, including the preparation and development of research instruments, instrument testing, data collection, data processing, and statistical analysis. This structured research period was intended to ensure that the collection and analysis of empirical data were conducted systematically and consistently with the research objectives.

The population of this study consisted of 308,229 individuals relevant to the research in Central Java. The required sample size was determined using a statistical sample-size calculation based on a 95% confidence level and a 5% margin of error. Based on the commonly used sample-size determination approach for large populations, a minimum sample of approximately 384 respondents was obtained. The use of a 95% confidence level and 5% margin of error is a widely accepted convention in quantitative survey research because it provides an appropriate balance between statistical precision and research feasibility (Hair, et al., 2019). This study targeted 384 respondents as the research sample.[40]

The endogenous variable Regional Resilience, exogenous variables Javanese Cultural Digitalization and Digital Literacy. In the proposed structural model, Javanese cultural digitalization and digital literacy were positioned as explanatory variables that were expected to contribute to

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[37] Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). SAGE Publications.
[38] Op.Cit
[39] Boone, H. N., Jr., & Boone, D. A. (2012). Analyzing Likert data. *Journal of Extension*
[40] Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage.

variations in regional resilience. This model was developed based on the theoretical assumption the digital transformation of cultural resources and the capacity of individuals to use and critically evaluate digital technologies may contribute to the strengthening of social and regional resilience.

The analysis was conducted using Structural Equation Modeling (SEM) with Analysis of Moment Structures (AMOS) as the statistical software. SEM was selected because it enables researchers to simultaneously examine relationships among multiple observed and latent variables and to evaluate both the measurement model and the structural model. Hair, et al. (2019), SEM is particularly appropriate for testing theoretically specified models involving latent constructs measured through multiple indicators. SEM allows researchers to assess the validity and reliability of measurement instruments through confirmatory factor analysis (CFA), while the structural component of the model can be used to test the hypothesized relationships among constructs.[41]

The SEM analysis in this study was conducted in two main stages. First, the measurement model was evaluated to determine whether the observed indicators adequately represented their respective latent constructs. Second, the structural model was evaluated to examine the hypothesized relationships between Javanese cultural digitalization, digital literacy, and regional resilience. This two stage approach is consistent with the recommended practice of distinguishing the assessment of the measurement model from the assessment of the structural model in covariance based SEM.

## RESULTS AND DISCUSSION

**Table 3**
**Validity and Reliability Test**

| Variable | Indeks Validity | Indeks Reliability |
|---|---|---|
| Regional resilience | 0,502-0,719 | 0,942 |
| Javanese cultural digitalization | 0,503-0,820 | 0,908 |
| Digital literacy | 0,619-0,820 | 0,914 |

Source: data analysis SPSS (2026)

**Table 4**
**Demograph Respondent**

| Characteristic | Frequency (F) | Percentage (%) |
|---|---|---|
| Gender | | |
| Male | 145 | 37 |
| Female | 247 | 63 |
| Age | | |
| 15-16 | 17 | 4.3 |
| 17-25 | 185 | 47.2 |
| 26-35 | 143 | 36.5 |
| 36-45 | 35 | 8.9 |
| < 46 | 12 | 3.1 |
| Education | | |
| Diploma or below | 168 | 42.86 |
| Bachelor's degree or higher | 224 | 57.14 |

Source: data analysis SPSS (2026)

[41] Op. Cit

**Confirmatory Factor Analysis Javanese Culture Digitalization**

The conceptual framework CFA Javanese Culture Digitalization of the study is presented in Figure 1**.**

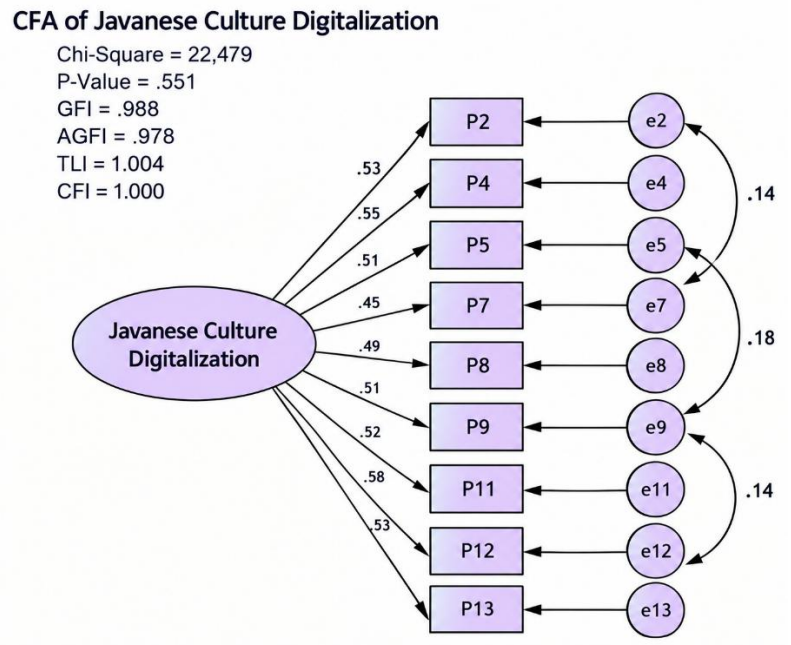



**Figure 1.** CFA Javanese Culture Digitalization

Source: Output data analysis AMOS (2026)

**Table 5**

**Standardized Loading Variable Javanese Culture Digitalization**

| Item | *Standardized Loading* ($\lambda$) | *Standardized Loading*$^2$ ($\lambda^2$) | *Standard Error* ($e(1-\lambda^2)$) | *CR* | *AVE* |
|---|---|---|---|---|---|
| P2 | 0,53 | 0,28 | 0,72 | | |
| P4 | 0,55 | 0,30 | 0,70 | | |
| P5 | 0,51 | 0,26 | 0,74 | | |
| P7 | 0,45 | 0,20 | 0,80 | | |
| P8 | 0,49 | 0,24 | 0,76 | 0,90 | 0,48 |
| P9 | 0,51 | 0,26 | 0,74 | | |
| P11 | 0,52 | 0,27 | 0,73 | | |
| P12 | 0,59 | 0,35 | 0,65 | | |
| P13 | 0,55 | 0,30 | 0,70 | | |

Source: Output data analysis AMOS (2026)

Based on table 5 CFA results show that most indicators of Javanese Culture Digitalization have standardized loading factors above 0.50, indicating adequate representation of the latent construct. Two indicators, P7 (0.45) and P8 (0.49), are slightly below the ideal threshold of 0.50. However, both were retained because they remain acceptable for social science research and have strong theoretical relevance to the construct.

The construct good reliability, with a Construct Reliability (CR) of 0.90, exceeding the recommended threshold of 0.70. The Variance Extracted (VE) is 0.48, slightly below the ideal value of 0.50. Nevertheless, this value can still be considered acceptable given the high CR and strong

theoretical support of the indicators (Fornell & Larcker, 1981)[42]. Overall, Javanese Culture Digitalization adequate reliability and convergent validity and is suitable for further structural analysis.

**Table 6**

***Goodness of Fit (GOF)* Variable Javanese Culture Digitalization**

| Fit Indeks | Fit Criteria | Result | Conclusion |
|---|---|---|---|
| *Chi-Square* | 35,50 | 22,48 | *Fit* |
| *P-Value* | > 0,08 | 0,55 | *Fit* |
| *GFI* | > 0,90 | 0,99 | *Fit* |
| *AGFI* | > 0,90 | 0,98 | *Fit* |
| *TLI* | > 0,90 | 1,00 | *Fit* |
| *CFI* | > 0,90 | 1,00 | *Fit* |

Source: Output data analysis AMOS (2026)

Based on table 6, *goodness-of-fit* test results indicate that the measurement model for Javanese Culture Digitalization the criteria for a *good fit*. Since there is no universal *cut-off* value for the Chi-Square statistic, model fit was evaluated comprehensively by considering all relevant *goodness of fit* indices. Overall, the results that the measurement model achieves an acceptable level of fit and is therefore suitable for further analysis**.**

**Confirmatory Factor Analysis Digital Literacy**

The conceptual framework CFA Digital Literacy of the study is presented in Figure 2**.**

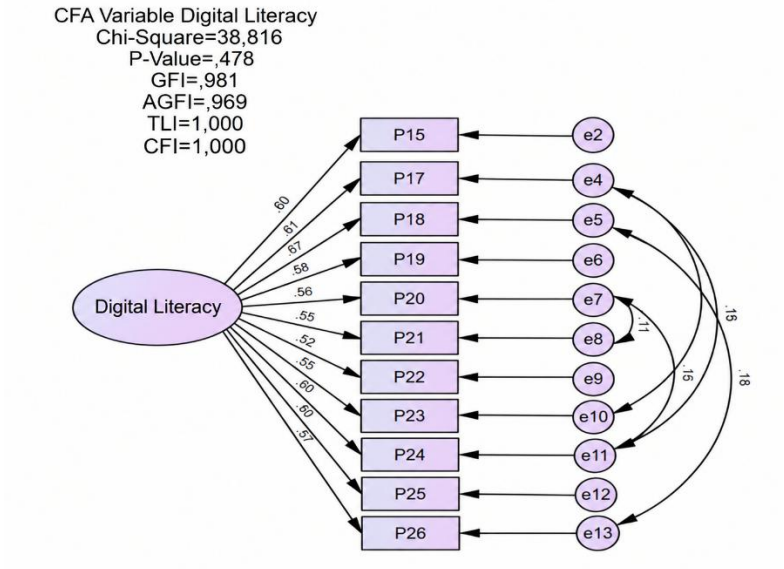



Figure 2. CFA Digital Literacy

Source: Output data analysis AMOS (2026)

[42] Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*

**Table 7**
**Standardized Loading Variable Digital Literacy**

| Item | *Standardized Loading (λ)* | *Standardized Loading² (λ²)* | *Standard Error (e(1-λ²)* | *CR* | *AVE* |
|---|---|---|---|---|---|
| P15 | 0,50 | 0,25 | 0,75 | 0,91 | 0,60 |
| P17 | 0,51 | 0,26 | 0,74 | | |
| P18 | 0,57 | 0,32 | 0,68 | | |
| P19 | 0,58 | 0,34 | 0,66 | | |
| P20 | 0,56 | 0,31 | 0,69 | | |
| P21 | 0,55 | 0,30 | 0,70 | | |
| P22 | 0,55 | 0,30 | 0,70 | | |
| P23 | 0,55 | 0,30 | 0,70 | | |
| P24 | 0,60 | 0,36 | 0,64 | | |
| P25 | 0,61 | 0,37 | 0,63 | | |
| P26 | 0,53 | 0,28 | 0,72 | | |

Source: Output data analysis AMOS (2026)

Based on table 7 variable digital literacy *standardized loading* values greater than 0.50. These values indicate that each indicator makes an adequate contribution to the Digital Literacy. Therefore, all indicators retained after the CFA process meet the criteria for convergent validity and can be maintained in the measurement model. These findings that indicators empirically provide an adequate representation of the digital literacy.

The results of the construct reliability (CR) value 0.91. This value exceeds the minimum 0.70, indicating a high level of internal consistency. The Variance Extracted (VE) value 0.60 also exceeds the minimum threshold of 0.50. This result indicates that the construct explains a greater proportion of the variance in its indicators than the variance attributable to measurement error, thereby providing evidence supporting the convergent validity of the digital literacy construct. Fornell and Larcker (1981)[43], CR value of ≥ 0.70 indicates adequate construct reliability, whereas VE value of ≥ 0.50 indicates satisfactory convergent validity.

**Table 8**
***Goodness of Fit (GOF)* Variable Digital Literacy**

| Fit Indeks | Fit Criteria | Result | Conclusion |
|---|---|---|---|
| *Chi-Square* | 35,50 | 38,81 | *Fit* |
| *P-Value* | > 0,08 | 0,48 | *Fit* |
| *GFI* | > 0,90 | 0,98 | *Fit* |
| *AGFI* | > 0,90 | 0,97 | *Fit* |
| *TLI* | > 0,90 | 1,00 | *Fit* |
| *CFI* | > 0,90 | 1,00 | *Fit* |

Source: Output data analysis AMOS (2026)

Based on table 8 the *goodness of fit* test results indicate that the measurement model for digital literacy the criteria for a *good fit*. Since there is no universal *cut-off* value for the Chi-Square statistic, model fit was evaluated comprehensively by considering all relevant *goodness of fit* indices. Overall,

[43] Op.Cit

the results that the measurement model achives an acceptable level of fit and is therefore suitable for further analysis**.**

**Confirmatory Factor Analysis Regional Resilience**

The conceptual framework CFA Regional Resilience of the study is presented in Figure 3**.**

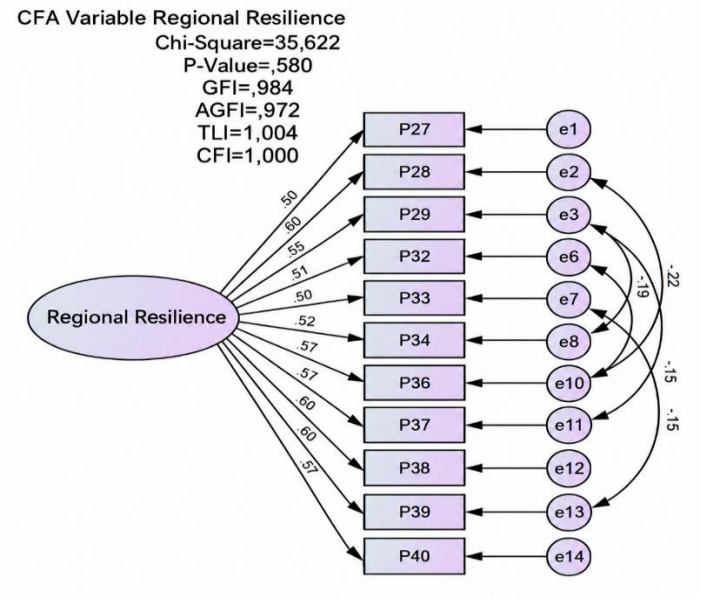



Figure 3. CFA Regional Resilience

Source: Output data analysis AMOS (2026)

**Table 9**

**Standardized Loading Variable Regional Resilience**

| Item | *Standardized Loading (λ)* | *Standardized Loading² (λ²)* | *Standard Error (e(1-λ²)* | *CR* | *AVE* |
|---|---|---|---|---|---|
| P27 | 0,50 | 0,25 | 0,75 | 0,91 | 0,60 |
| P28 | 0,60 | 0,36 | 0,64 | | |
| P29 | 0,55 | 0,30 | 0,70 | | |
| P32 | 0,51 | 0,26 | 0,74 | | |
| P33 | 0,50 | 0,25 | 0,75 | | |
| P34 | 0,52 | 0,27 | 0,73 | | |
| P36 | 0,57 | 0,32 | 0,68 | | |
| P37 | 0,57 | 0,32 | 0,68 | | |
| P38 | 0,60 | 0,36 | 0,64 | | |
| P39 | 0,60 | 0,36 | 0,64 | | |
| P40 | 0,57 | 0,32 | 0,68 | | |

Source: Output data analysis AMOS (2026)

Based on table 9, the results convergent validity indicate all items measuring the regional resilience *standardized factor loading* values above 0.50. This finding that each observed indicator adequately represents the underlying construct. All retained items satisfy the criteria convergent validity and considered appropriate for measuring the regional resilience construct.

The *Construct Reliability* (CR) value of 0.91, which exceeds the recommended minimum threshold of 0.70. This result indicates a high level of internal consistency and regional resilience construct has satisfactory reliability. *Average Variance Extracted* (AVE) value is 0.60, exceeding the

recommended threshold of 0.50. This indicates that the construct explains a substantial proportion of the variance in its observed indicators and adequate convergent validity. The criteria proposed by Fornell and Larcker (1981)[44], CR value above 0.70 and an AVE value above 0.50 indicate satisfactory construct reliability and convergent validity, respectively. Overall, the measurement results confirm that the regional resilience construct meets the required criteria for both reliability and convergent validity.

**Table 10**
***Goodness of Fit (GOF)* Variable Regional Resilience**

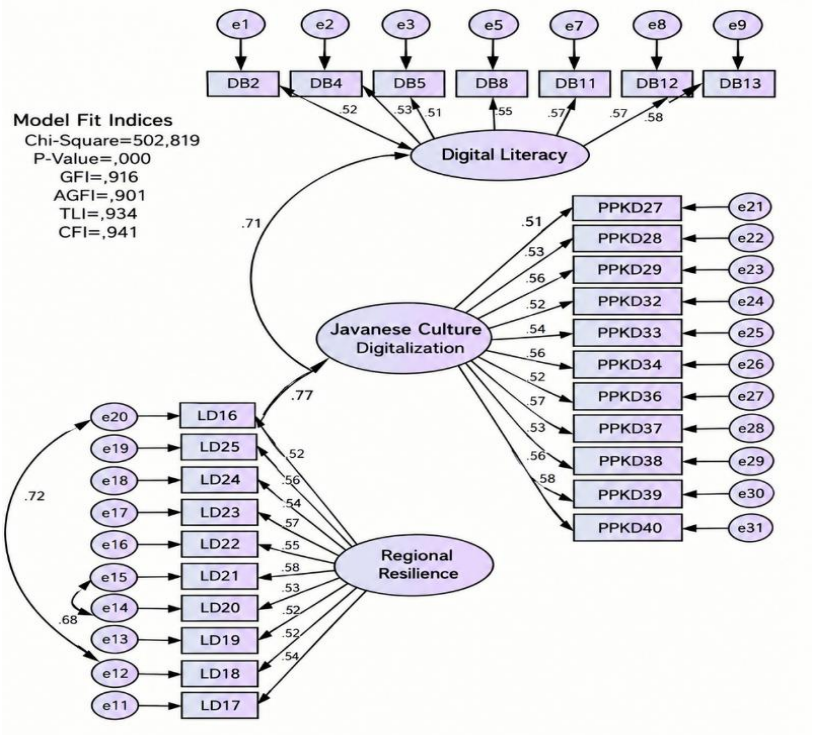
| Fit Indeks | Fit Criteria | Result | Conclusion |
|---|---|---|---|
| *Chi-Square* | 35,50 | 35,62 | *Fit* |
| *P-Value* | > 0,08 | 0,58 | *Fit* |
| *GFI* | > 0,90 | 0,98 | *Fit* |
| *AGFI* | > 0,90 | 0,97 | *Fit* |
| *TLI* | > 0,90 | 1,00 | *Fit* |
| *CFI* | > 0,90 | 1,00 | *Fit* |

Source: Output data analysis AMOS (2026)

Based on table 10 the *goodness of fit* test variable regional resilience the criteria for a *fit*. Since there is no universal *cut-off* value for the Chi-Square statistic, model fit was evaluated comprehensively by considering all relevant *goodness of fit* indices. Overall, the results that the measurement model achives an acceptable level of fit and is therefore suitable for further analysis**.**

**Correlation Variable**

The conceptual framework Correlation is presented in Figure 4**.**




[44] Op.Cit

Figure 4. Correlation Variable
Source: Output data Correlation analysis AMOS (2026)

**Structural Equation Model**

The conceptual framework Correlation is presented in Figure 5**.**

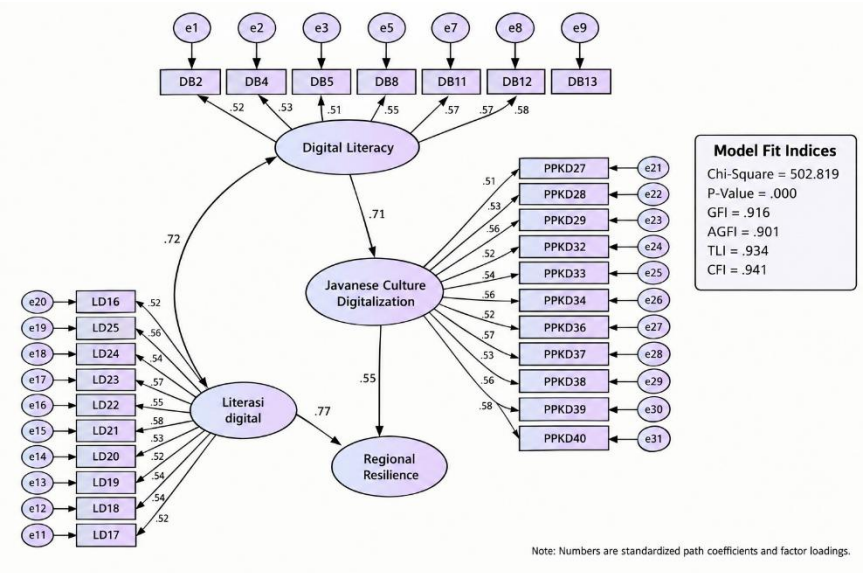



Figure 5. Structural Equation Model
Source: Output data SEM analysis AMOS (2026)

**Table 11**
***Goodness of Fit (GOF)* Structural Equation Model**

| Fit Indeks | Fit Criteria | Result | Conclusion |
|---|---|---|---|
| *Chi-Square* | 35,50 | 550,83 | *Fit* |
| *P-Value* | > 0,08 | 0,00 | *Fit* |
| *GFI* | > 0,90 | 0,91 | *Fit* |
| *AGFI* | > 0,90 | 0,90 | *Fit* |
| *TLI* | > 0,90 | 0,93 | *Fit* |
| *CFI* | > 0,90 | 0,94 | *Fit* |

Source: Output data analysis AMOS (2026)

Based on table 11 the *goodness of fit* test results indicate that the measurement model for structural equation model the criteria for a *fit*. Since there is no universal *cut-off* value for the Chi-Square statistic, model fit was evaluated comprehensively by considering all relevant *goodness of fit* indices.

**Table 12**
**Validity Discriminant**

| Variable | Javanese cultural digitalization | Digital literacy | Regional resilience |
|---|---|---|---|
| Javanese cultural digitalization | **0,693** | | |
| Digital literacy | 0,768 | **0,775** | |
| Regional resilience | 0,772 | 0,862 | **0,775** |

Source: Output data analysis AMOS (2026)

Based on table 12, discriminant validity was assessed using the Fornell–Larcker criterion. The square root of the Average Variance Extracted (√AVE) was 0.775 for Digital Literacy, 0.693 for Javanese Culture Digitalization, and 0.775 for Regional Resilience. According to the Fornell–Larcker criterion, the square root of AVE for each construct should be greater than its correlations with the other constructs. However, the √AVE of Javanese Culture Digitalization (0.693) was lower than its correlations with Digital Literacy (0.768) and Regional Resilience (0.772). Furthermore, the correlation between Digital Literacy and Regional Resilience (0.862) was higher than the √AVE of both constructs (0.775). Therefore, the Fornell–Larcker criterion for discriminant validity was not fully satisfied. In addition, the AVE value of Javanese Culture Digitalization (0.48) was below the recommended threshold of 0.50, indicating that its convergent validity also requires further consideration.

**Table 13**
**Path Analysis**

| Hypothesis | Path Analysis | C.R. | P |
|---|---|---|---|
| H1 | Javanese cultural digitalization → regional resilience | 2,94 > 1,96 | 0,003 < 0,05 |
| H2 | Digital literacy → regional resilience | 5,68 > 1,96 | 0,000 < 0,05 |

Source: Output data analysis AMOS (2026)

Based on table 13, the *path analysis* indicates that both research hypotheses received empirical. **H1,** the effect of Javanese cultural digitalization on regional resilience a *Critical Ratio* (C.R.) 2.94, which exceeds the critical value of 1.96, with a significance level of 0.003 < 0.05. This result indicates that Javanese cultural digitalization has a positive and statistically significant effect on regional resilience.

**H2**, the effect of digital literacy on regional resilience *Critical Ratio* of 5.68, which is higher than the critical value of 1.96, with a significance level of 0.000 < 0.05. These findings indicate that digital literacy has a positive and statistically significant effect on regional resilience.

Overall, the *path analysis* demonstrates that Javanese cultural digitalization and digital literacy are two variables that significantly contribute to regional resilience. The findings provide empirical evidence that the use of digital technologies to preserve, disseminate, and facilitate access to Javanese cultural heritage, supported by adequate levels of digital literacy, is associated with the strengthening of regional resilience. These results provide a basis for further discussion of how cultural transformation in digital spaces and the development of digital literacy capacities can contribute to strengthening community resilience at the regional level.

**Discussion**

Javanese cultural digitalization with regional resilience

The findings reveal that the most dominant indicator of Javanese Culture Digitalization is respondents' ability to rediscover previously created Javanese cultural content through search and recommendation features on digital platforms. This finding indicates that cultural digitalization is not merely concerned with the availability of cultural content in digital formats, but also with the extent to which such content can be rediscovered, accessed, and repeatedly consumed by communities in their everyday lives. Thus, the presence of Javanese culture in digital spaces becomes more meaningful when individuals have opportunities to actively encounter and rediscover various forms of cultural heritage through search mechanisms and algorithm-based recommendations.

This finding can be explained through Manovich's (2001) concept of digital culture, particularly the logic of the database. In digital environments, cultural content no longer needs to be presented through a fixed and linear narrative structure.[45] Instead, it can be organized as a collection of discrete data elements that enables users to search, categorize, navigate, and retrieve information through non-linear pathways. The ability to rediscover Javanese cultural content therefore indicates a transformation in the way communities interact with cultural heritage. Rather than receiving cultural information exclusively through conventional channels, users can determine which cultural content they wish to explore, when they want to access it, and how they use the information. The contribution of cultural digitalization to regional resilience does not originate solely from the archival preservation of cultural materials, but also from the capacity of digital technologies to maintain the visibility, accessibility, and continued presence of cultural heritage in everyday community life.

Hjarvard's (2014) theory of mediatization, which explains that media have become increasingly integrated into social and cultural institutions, allowing media logic to influence patterns of communication, representation, and social interaction.[46] Javanese cultural digitalization, search and recommendation features constitute important elements of digital media logic that influence how users encounter and interact with cultural content. Cultural materials that were previously accessible primarily through particular cultural spaces can now be encountered through digital platforms in the form of videos, images, texts, digital archives, and other forms of representation. Consequently, digitalization does not simply transfer Javanese culture from physical to digital spaces; it also introduces new mechanisms through which cultural content becomes visible, accessible, and circulated among users.

From another perspective, Deuze (2006) digital environments, individuals are no longer positioned merely as passive recipients of information but are provided with opportunities to participate in the processes of searching, using, producing, and redistributing content.[47] The ability of individuals to rediscover older Javanese cultural content reflects an active form of engagement with cultural heritage. Cultural materials that were previously stored in archives or conventional documentation can re-emerge in digital spaces and become accessible to different generations. This

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[45] Manovich, L. (2001). *The language of new media*. MIT Press

[46] Hjarvard, S. (2014). Mediatization and cultural and social change: An institutional perspective. In K. Lundby (Ed.), *Mediatization of communication* (pp. 199–226). De Gruyter Mouton.

[47] Deuze, M. (2006). Participation, remediation, bricolage: Considering principal components of a digital culture. *The Information Society*

process may contribute to the continuity of cultural identity by enabling cultural knowledge, symbols, practices, and representations to remain present in contemporary social interactions.

The finding is consistent with Revianur (2020), the digitalization of cultural heritage can serve as an alternative mechanism for cultural preservation through the use of digital technologies. Digitalization functions not only as a means of documentation but also as a mechanism for expanding public access to cultural heritage information. This perspective is particularly relevant to the present finding because the ability to rediscover cultural content emerged as the dominant indicator of Javanese Culture Digitalization. It suggests that the effectiveness of cultural digitalization should not be assessed solely by the quantity of cultural materials converted into digital formats, but also by the extent to which communities can access, rediscover, and interact with those materials.

The finding is also consistent with Dwihantoro et al. (2023), the digitalization of traditional arts through social media platforms.[48] Their study that social media can provide opportunities for traditional arts to be documented, promoted, and introduced to broader audiences. This mechanism helps explain why the ability to rediscover cultural content through digital platforms is particularly important in the present study. When cultural content is available and easily discoverable, opportunities for interaction between communities and their cultural heritage are also increased. Digital platforms can therefore function as contemporary spaces through which cultural expressions remain visible and accessible beyond traditional cultural settings.

Furthermore, Nirwana and Nugroho (2024), through the concept of digital cosmopolitanism, that digital spaces can serve as environments for the transformation and sustainability of traditional arts and culture.[49] Digital media allow local cultural expressions to be represented and recirculated in formats compatible with contemporary patterns of digital communication. The present finding extends this perspective that accessibility and the ability to rediscover cultural content constitute important mechanisms for maintaining the presence of local culture amid changes in the communication environment. In this regard, digitalization provides opportunities for local cultural resources to remain connected to contemporary users rather than being restricted to conventional cultural institutions or physical spaces.

Digital literacy with regional resilience

Digital Literacy in this study is primarily reflected in respondents' habit of considering the social impact of the information they produce and disseminate in digital spaces. The high contribution of this indicator suggests that digital literacy among respondents is not limited to the ability to access and understand information, but also involves the capacity to consider the potential social consequences before engaging in digital communication. This finding indicates that ethical and reflective dimensions constitute important components of digital competence, particularly in a social environment that is increasingly dependent on digital media.

The finding further suggests that Digital Literacy should be understood as a multidimensional competence encompassing technical, cognitive, evaluative, social, and ethical dimensions. Harmawati et al. (2024) identify ethics and safety in the use of digital media as important

[48] Dwihantoro, P., Susanti, D., Sukmasetya, P., & Faizah, R. (2023). Digitalization of Njanen traditional arts: A cultural preservation strategy through social media platforms. *Madaniya*

[49] Nirwana, A., & Nugroho, D. P. (2024). Digital cosmopolitanism: A proposed strategy for the sustainability of traditional arts and culture in the digital era. *Jurnal Kajian Seni*

components in assessing digital literacy. This perspective reinforces the present finding that technical competence in using digital technologies needs to be accompanied by awareness of how information is used and how digital actions may affect others.[50] Thus, digital literacy is not merely concerned with whether individuals are able to operate digital media, but also with how responsibly they use digital technologies and information.

Consideration of social consequences becomes particularly important because social media enables information to be produced and disseminated rapidly across extensive networks of users. Barzilai et al. (2023) the ability to evaluate information is associated with distinguishing accurate from inaccurate information and with more responsible information-sharing behavior.[51] This finding supports the interpretation that digital literacy involves not only the ability to receive and process information but also decision-making before information is transmitted to other users. In this regard, the dominant indicator identified in the present study reflects a form of reflective digital behavior in which users consider the potential consequences of their communication before sharing information.

The findings are also relevant to research on the dissemination of false and misleading information through social media. Roozenbeek et al. (2023) indicates that social cues combined with misinformation warnings can reduce the sharing of misleading information and improve the quality of information-sharing behavior.[52] This evidence suggests that information-sharing behavior is influenced not only by users' technical capabilities but also by social norms, contextual cues, and awareness of the potential consequences of sharing information. The present study extends this perspective that consideration of social impacts is particularly salient within the digital literacy construct.

Kurniasih et al. (2024) highlight the relevance of information literacy in mitigating the spread of hoaxes on social media.[53] Their findings emphasize the importance of users' ability to identify potentially misleading information and make informed decisions before sharing it through social media. This evidence reinforces the present finding that awareness before disseminating information constitutes an important dimension of digital competence, particularly in an information environment characterized by rapid and extensive content circulation.

The ethical dimension of digital literacy is particularly relevant to Regional Resilience. Suranata et al. (2024), through the development and initial evaluation of digital literacy and digital resilience measures among university students in ASEAN countries, digital literacy and digital resilience can be systematically conceptualized and measured as related competencies for navigating an increasingly dynamic digital environment.[54] Their digital literacy framework encompasses

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[50] Harmawati, Y., Sapriya, Abdulkarim, A., Bestari, P., & Sari, B. I. (2024). Data of digital literacy level measurement of Indonesian students: Based on the components of ability to use media, advanced use of digital media, managing digital learning platforms, and ethics and safety in the use of digital media. *Data in Brief*

[51] Barzilai, S., Mor-Hagani, S., Abed, F., Tal-Savir, D., Goldik, N., Talmon, I., & Davidow, O. (2023). Misinformation is contagious: Middle school students learn how to evaluate and share information responsibly through a digital game. *Computers & Education*

[52] Roozenbeek, J., van der Linden, S., Goldberg, B., Rathje, S., & Lewandowsky, S. (2023). Psychological inoculation improves resilience against misinformation on social media. *Science Advances*

[53] Kurniasih, E., Damayani, N. A., & Zubair, F. (2024). The role of information literacy in mitigating the spread of hoaxes on social media. *Khizanah al-Hikmah: Jurnal Ilmu Perpustakaan, Informasi, dan Kearsipan*

[54] Suranata, K., Apriliana, P. A., Candiasa, I. M., Herawati, N. T., Bakar, A. Y. A., & Costa, A. D. (2024). Development and initial psychometric evaluation of digital literacy and resilience scales among university students in ASEAN. *International Journal of Learning and Teaching*

information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving, while digital resilience concerns individuals' capacity to understand, learn, adapt, and recover within digital environments. This perspective is consistent with the present study, in which digital literacy represents an important human capability for responding to the social consequences of digital communication.

The present findings extend this perspective that awareness of the social consequences of shared information is the most dominant indicator of the Digital Literacy construct. This result suggests that digital literacy is not merely an individual's capacity to adapt to technological change, but also the capacity to manage the social consequences of digital activities. Such a capacity is relevant to Regional Resilience because digitally mediated social environments require individuals to recognize how their actions and communication may affect other members of the community. Responsible digital behavior can therefore contribute to maintaining constructive patterns of communication and social interaction.

The relationship between digital literacy and social resilience can also be understood from the perspective of social media as a public communication environment. Recent research on *social media information literacy* emphasizes the importance of individuals' ability to understand and critically evaluate information encountered through social media, particularly within information environments characterized by information overload, news avoidance, and the circulation of misleading or conspiratorial content. Such competencies are relevant to individuals' capacity to navigate complex information environments and participate meaningfully in digital society.

## CONCLUSION & MANAGERIAL IMPLICATIONS

### Conclusion

The findings further reveal that the most dominant indicator of Digital Literacy is the respondents' tendency to consider the social consequences of the information they produce and disseminate through digital platforms. This result highlights the importance of the ethical and reflective dimensions of digital literacy. Digital competence should therefore not be understood solely in terms of technical skills or information access, but also as the ability to evaluate information, anticipate its potential consequences, and communicate responsibly within digital environments.

Meanwhile, the most dominant indicator of Javanese Culture Digitalization concerns respondents' ability to rediscover older Javanese cultural content through search and recommendation features on digital platforms. This finding suggests that the contribution of cultural digitalization is associated not merely with the preservation of cultural materials in digital formats, but also with their discoverability, accessibility, and continued circulation in everyday digital environments. Digital platforms can therefore provide opportunities for local cultural knowledge and representations to remain visible and accessible across generations.

A key contribution of this study is the integration of human digital capability and digitally mediated cultural resources into the explanation of Regional Resilience. The results suggest that digitalization alone is insufficient to generate meaningful social outcomes. Digital platforms provide the infrastructure and space through which cultural resources can be represented and circulated, whereas Digital Literacy enables individuals to critically and responsibly interact with those resources. The stronger coefficient of Digital Literacy in the structural model further emphasizes

the importance of human capability in transforming digital resources into meaningful social outcomes.

Overall, this study contributes to the literature by positioning digital literacy and cultural digitalization as complementary mechanisms through which communities can maintain cultural continuity and strengthen their capacity to navigate changes in the digital environment. The findings also suggest that Regional Resilience should be considered not only from economic, institutional, or environmental perspectives but also from the perspective of digital capability, responsible digital behavior, and the continued accessibility of local cultural resources.

Managerial Implication

The findings of this study provide important managerial implications for local governments, cultural institutions, educational organizations, and other stakeholders seeking to strengthen Regional Resilience through digital transformation. The stronger effect of Digital Literacy on Regional Resilience ($\beta = 0.77$, C.R. = 5.68, $p < 0.001$) compared with Javanese Culture Digitalization ($\beta = 0.55$, C.R. = 2.94, $p = 0.003$) indicates that strengthening regional resilience requires more than providing digital technologies and digitizing cultural resources. It also requires improving the capacity of communities to use digital technologies critically, ethically, and responsibly. Therefore, local governments should develop digital literacy programs that go beyond basic technical skills by emphasizing information evaluation, verification before sharing, awareness of the social consequences of digital communication, ethical online behavior, and responsible use of digital media. At the same time, Javanese Culture Digitalization initiatives should not be limited to documenting and storing cultural heritage in digital formats, but should also prioritize accessibility, discoverability, and public engagement with digital cultural content**.** Digital cultural repositories and platforms should incorporate effective search functions, appropriate categorization and metadata, recommendation features, and user-friendly interfaces so that communities, particularly younger generations, can easily rediscover and engage with Javanese cultural heritage. Local governments and cultural institutions can also integrate local cultural content into digital literacy programs, educational activities, and community-based initiatives to facilitate intergenerational cultural transmission. In this regard, Javanese Culture Digitalization provides the cultural resources and digital space necessary for cultural continuity, while Digital Literacy equips communities with the capabilities to access, understand, evaluate, and utilize these resources responsibly**.** Integrating these two dimensions can therefore provide a more comprehensive managerial strategy for strengthening the social and cultural foundations of Regional Resilience in an increasingly digital environment.

## LIMITATIONS & FUTURE SCOPE

This study has several limitations that should be considered when interpreting its findings. First, the study employed a quantitative cross-sectional design, in which data were collected at a single point in time. Although this approach enables the identification of relationships and effects among the variables, it does not capture changes in community behavior or Regional Resilience over time. Second, the research focused on three main constructs, Digital Literacy, Javanese Culture Digitalization, and Regional Resilience. Other factors that may contribute to regional resilience, such as social capital, community participation, institutional capacity, social trust, cultural identity, digital inclusion, and local government support, were not incorporated into the proposed model. Third, the

variables were measured using self-reported responses, which may be subject to subjective perceptions, differences in respondents' interpretation of the measurement items, and potential social desirability bias. Fourth, the study specifically examined Javanese Culture Digitalization, meaning that the cultural and social characteristics of the Javanese may influence the findings and consequently limit their generalizability to other cultural or regional contexts.

These limitations provide several opportunities for future research. First, future studies could employ a longitudinal research design to examine how Digital Literacy, Javanese Culture Digitalization, and Regional Resilience evolve over time and how the relationships among these constructs change in response to technological and social developments. Second, future research could extend the conceptual model by incorporating additional variables, such as social capital, community participation, institutional capacity, digital inclusion, cultural identity, and social trust, to provide a more comprehensive explanation of the mechanisms underlying Regional Resilience. Third, a mixed-methods approach could be adopted by combining quantitative surveys with qualitative interviews or focus group discussions to obtain deeper insights into how communities use digital technologies to access, preserve, reinterpret, and develop local cultural resources. Fourth, future studies could conduct comparative research across regions or cultural contexts to determine whether the relationships between cultural digitalization, digital literacy, and Regional Resilience are context specific or applicable across different cultural settings.

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**Clinical Trial Number**

Clinical trial number: not applicable.

**Ethics Statement**

This study involving human participants was conducted in accordance with the ethical principles and guidelines established by the relevant institutional ethics committee. The research protocol was reviewed and approved by the University Borobudur and University Defensive, under approval number B/EXT/VIII/10, in accordance with the applicable ethical guidelines and regulations. All participants were informed about the purpose of the study and their participation in the research, and informed consent was obtained prior to data collection.

**Consent to Participate**

Informed consent was obtained from all participants prior to their participation in this study. Participants were informed about the purpose of the research and the voluntary nature of their participation. They were also informed of their right to withdraw from the study at any time without penalty.

**Consent to Publish**

Consent to publish was not applicable to this study because the manuscript does not contain personally identifiable information requiring specific consent for publication. The findings are presented in an aggregated form to protect participants' privacy and confidentiality.

**Data Availability Statement**

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

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