

RESEARCH TREND: *SMART PEOPLE AND DIGITAL LITERACY* IN THE *SMART CITY* ERA

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ABSTRACT

This research aims to describe the trends and development directions of global research concerning Smart People, Digital Literacy, and Smart City. The method employed is Social Network Analysis using a quantitative bibliometric approach. The primary focus of this research mapping is the interconnectedness and evolution of research on the concepts of Smart People and Digital Literacy within the context of Smart City development in existing research. A Smart City is not solely determined by advancements in infrastructure and digital technology but also by the quality of human resources capable of adapting to these changes. In this context, Smart People are a key element, reflecting individuals' ability to think critically, innovate, and utilize technology effectively. One of the main foundations of Smart People is Digital Literacy, which is the ability to understand, evaluate, and wisely and productively use digital information. The connection between Smart People and Digital Literacy is crucial in realizing urban communities that are participatory, adaptive, and ready to face digital transformation. Metadata was collected using Publish or Perish (PoP) software from the Google Scholar database with the keywords "Smart People," "Digital Literacy," and "Smart City" during the 2020-2024 period. The data was exported in two formats: CSV and RIS. The CSV file was processed using Pivot Tables in Microsoft Excel to present the statistical distribution of publications, while the RIS file was analyzed using the VOSviewer application to map author networks, keywords, and research trends. Bibliometric visualizations are presented in three main forms: Network Visualization, Overlay Visualization, and Density Visualization. This research makes an important contribution to understanding how the trends and research focus on Smart People and Digital Literacy are developing globally. The findings can also serve as a reference for formulating Smart City development policies that are not only technology-based but also focused on empowering the community as the main actors of change.

Keywords: Bibliometrics, Smart People, Digital Literacy, Smart City

INTRODUCTION

The development of Information and Communication Technology (ICT) in Indonesia has advanced rapidly, driven by digital transformation across the education, government, industrial, and business sectors. As the most populous country in Southeast Asia, Indonesia represents a significant potential market for digital technology. According to APJII, the number of internet users in Indonesia reached 221,563,479 in 2024, with a penetration rate of 79.5% out of a total population of 278,696,200, a significant increase from 64.8% in 2018. The expansion of digital infrastructure, including the widespread adoption of 4G networks and the preparation for 5G implementation, has accelerated this progress.

Since 2017, the Indonesian government, through the Ministry of Communication and Information Technology (Kominfo), has implemented the "Towards 100 Smart Cities Movement" in collaboration with various ministries and institutions. This initiative aims to develop Smart City

masterplans to enhance public service quality and government efficiency. The program is also supported by technical training provided by BPSDMP Kominfo.

Nevertheless, challenges such as the digital divide, data security, and misuse of technology remain. Therefore, it is crucial for both the government and the public to improve digital literacy. As Sutrisno et al. (2024) emphasized, enhancing digital literacy is essential to ensure that technology can be used wisely across all levels of society.

The Smart City concept is closely linked to the transformation of digital literacy, which integrates ICT into urban infrastructure, public services, and connectivity to create efficient, sustainable, and participatory urban living. Putrayasa (2024) highlighted that this transformation involves the development of digital literacy to accelerate technology adoption by empowering citizens with the skills to access, evaluate, and utilize digital information.

This study employs bibliometric analysis and global research trend mapping to explore the development of the Smart People and Digital Literacy concepts in scientific literature, as well as their relevance to sustainable Smart City development. By examining author collaboration networks, keyword distribution, and thematic research directions from 2020 to 2024, this study provides insights into Indonesia's position in the global landscape of smart society development.

RESEARCH QUESTIONS

The research questions in this study can be formulated as follows:

1. What are the trends and directions of global research development regarding *Smart People* and *Digital Literacy* in the context of *Smart City* development during the 2020–2024 period?
2. To what extent is the relationship between the concepts of *Smart People* and *Digital Literacy* significant in supporting *Smart City* development?
3. How can the network of author collaboration, dominant keywords, and academic contributions be identified from related publications?

RESEARCH OBJECTIVES AND BENEFITS

This study aims to:

1. Identify global trends in scientific publications addressing the themes of *Smart People* and *Digital Literacy* in the context of *Smart City* development over the past five years.
2. Analyze the relationship between the concepts of *Smart People* and *Digital Literacy* as foundational elements in the development of *Smart Cities* based on public participation.
3. Present visualizations of author collaboration networks, keywords, and thematic maps to provide a comprehensive overview of research through a bibliometric approach.

This research has two primary benefits:

1. Theoretical Benefit: It offers a scholarly contribution to the development of studies on *Smart People* and *Digital Literacy* as critical elements within the *Smart City* framework. This study also enriches academic references by employing a bibliometric approach, which has been rarely applied systematically within the field of communication studies.
2. Practical Benefit: The findings of this research can serve as a reference for policymakers, technology practitioners, and academics in formulating *Smart City* development strategies that emphasize the importance of enhancing human resource quality through strengthened *Digital Literacy*. It also provides practical value for local governments currently developing or planning to initiate *Smart City* programs.

LITERATURE REVIEW

1. Smart City

The concept of a Smart City has evolved significantly, moving beyond a sole focus on digital infrastructure to also encompass social, cultural, and public participation aspects. A Smart City is defined as a city capable of integrating digital technologies to improve efficiency, transparency in public services, and citizen engagement in urban development (Kementerian Kominfo, 2020).

2. Smart People

Smart People is one of the six core pillars in Smart City development. It represents citizens who possess critical thinking abilities, engage in lifelong learning, and use technology creatively and responsibly. In various studies, *Smart People* is considered a driving force in the transition toward an inclusive and sustainable digital society (Putrayasa, 2024).

3. Digital Literacy

Digital Literacy refers to the ability to access, evaluate, utilize, and create digital information wisely and productively. It encompasses not only technical skills but also cognitive and ethical capabilities in navigating digital content. This literacy is essential for empowering society to become not merely passive consumers of technology, but also active and responsible producers of information (Sutrisno et al., 2024).

4. Google Scholar Database

Google Scholar was launched in 2004 by Google as a scientific publication database providing access to reputable national and international journals. Rafika et al. (2017) note that in 2004, Google introduced its latest service, Google Scholar (known in Indonesian as Google Cendekia), offering full and free PDF access to a wide range of academic literature. Primarily used by students and researchers, Google Scholar facilitates comprehensive academic literature searches from a single platform. Its database includes peer-reviewed papers, theses, books, abstracts, and articles from various academic institutions. The platform displays the most relevant results on the first page and is equipped with tools to track, analyze, and visualize research outputs efficiently. Researchers can filter by year, author, keyword, and publisher via its dashboard.

5. Publish or Perish (PoP)

Publish or Perish (PoP) is a free software tool for retrieving metadata of scholarly works across various academic fields. It can access metadata from CrossRef, Google Scholar, Google Scholar Profiles, Microsoft Academic, PubMed, Scopus, and Web of Science. As stated by Asy'ari et al. (2021), Harzing's *Publish or Perish* is a freely available software that functions as a research tool to facilitate the retrieval of well-organized article data from interconnected publication platforms such as Google Scholar, Microsoft Academic, Scopus, and Web of Science, thereby aiding researchers in conducting literature reviews. PoP analyzes data using traditional literature review methods and provides metadata filtering features such as publication name, journal type, keywords, and title words to help researchers locate journal metadata more accurately.

6. VOSviewer

VOSviewer (VV) is a software application used to visualize bibliometric maps from bibliographic data such as titles, authors, journals, and more. It is widely used in research for bibliometric analysis, topic mapping, and identifying frequently cited references. As Jan & Ludo (2010) explain, "*VOSviewer can, for example, be used to construct maps of authors or journals based on co-citation data or to construct maps of keywords based on*

co-occurrence data." VOSviewer includes diverse visualization features such as zooming, scrolling, and searching, which facilitate map exploration particularly useful when working with a relatively large number of items (e.g., at least 100 items). The software supports various dataset formats including RIS, EndNote, and RefWorks, and it can read data from sources such as Google Scholar, Scopus, Web of Science, Dimensions, and PubMed, including API-based access from CrossRef and Semantic Scholar. In practice, VV assists researchers in identifying research topic trends and discovering new research opportunities (Effendy et al., 2021).

METHOD

This study employs a descriptive quantitative approach through bibliometric analysis to map journal metadata from Google Scholar related to *Smart People*, *Digital Literacy*, and *Smart City*, with the aim of identifying research development trends and providing direction for future studies. According to Sulisty Basuki (2002) in Royanin & Idhani (2018), the objective of bibliometric analysis is to explain the process of written communication and the nature and direction of its development through descriptive, quantitative, and analytical methods. Bibliometrics helps to describe the evolution of scientific communication within a particular discipline.

The data, comprising scientific publications from 2020 to 2024, were collected using the *Publish or Perish* (PoP) software sourced from Google Scholar, using the keywords "Smart People, Digital Literacy, Smart City." From the total of 955 articles retrieved, 20 articles were selected for further analysis. Trend analysis was conducted using the *VOSviewer* software, which is used to construct and visualize bibliometric networks (Van Eck & Waltman, 2017). According to Kamariah (2013), bibliometric analysis is the application of statistical methods to literature such as books and online publications. Roemer & Borchardt (2015) define bibliometrics as "*a set of quantitative methods used to measure, track, and analyze print-based scholarly literature.*" Adi Wijaya (2018) further states that bibliometric analysis includes elements such as authorship, publication year, journal, title, keywords, abstract, citations, h-index, and co-citation.

This study focuses on identifying the structure of the knowledge network and research topic trends in the literature concerning *Smart People* and *Digital Literacy*. Secondary data were collected in CSV format (for statistical analysis) and RIS format (for network analysis) for further examination.

RESULTS AND DISCUSSION

The metadata of scientific publications was collected using the *Publish or Perish* (PoP) application, based on data from Google Scholar, for the period 2020–2024. A total of 955 relevant scientific articles were identified using the keywords "*Smart People*," "*Digital Literacy*," and "*Smart City*."

Table 1. Top 20 Articles According to Google Scholar Ranking

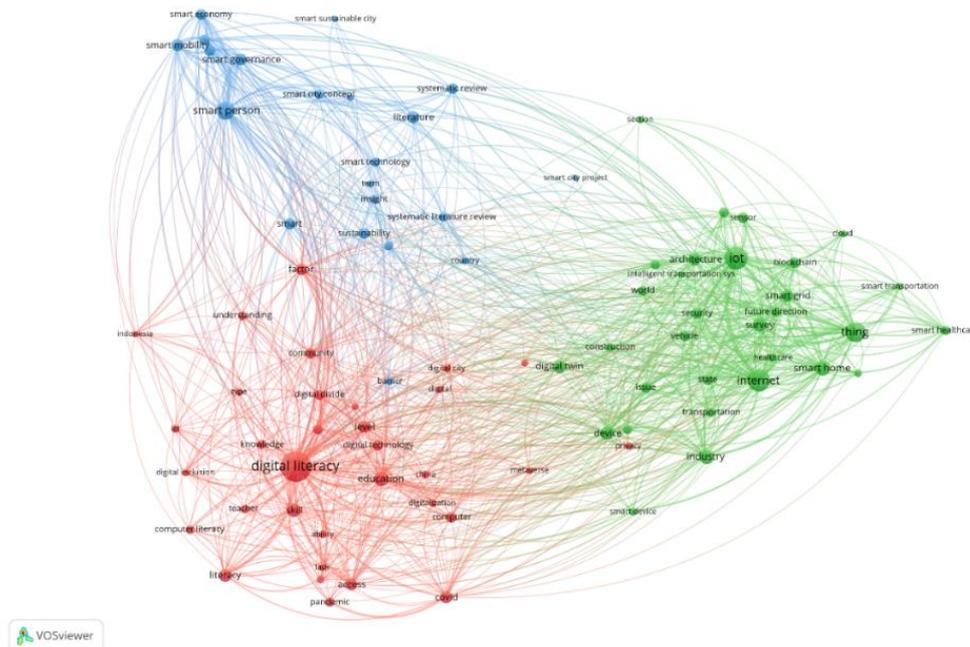
No	Cites	Authors	Title	Year	Source	Publisher	GSRank	CitesPerYear	CitesPerAuthor	AuthorCount
1	113	SY Shin, D Kim, SA Chun	Digital divide in advanced <i>Smart City</i> innovations	2021	Sustainability	mdpi.com	1	28.25	38	3
2	7	M Fazil, A Fahmi, A Riski	<i>Digital Literacy</i> in building a <i>Smart City</i> at banda aceh	2022	International Journal of Engineering ...	academia.edu	2	2.33	2	3
3	19	P Lister	Smart learning in the community: Supporting citizen digital skills and literacies	2020	Distributed, Ambient and Pervasive Interactions: 8th ...	Springer	3	3.8	19	1
4	2	D Lee, MM Kang, HJ Kim	The human dimension of smart cities: Examining antecedents of citizens' <i>Smart City</i> policy literacy	2024	International Review of ...	journals.sagepub.com	4	2	1	3
5	3	T Tanantong, P Moolngearn, T Kraiwit...	People skills in the 21st century: A perspective on the <i>Smart City</i> in an emerging economy	2024	Human Behavior ...	Wiley Online Library	5	3	1	4
6	70	H Alizadeh, A Sharifi	Toward a societal <i>Smart City</i> : Clarifying the social justice dimension of smart cities	2023	Sustainable Cities and Society	Elsevier	6	35	35	2
7	129	O Kolotouchkina, CL Barroso, JLM Sánchez	Smart cities, the digital divide, and people with disabilities	2022	Cities	Elsevier	7	43	43	3
8	69	M Masucci, H Pearsall, A Wiig	The <i>Smart City</i> conundrum for social justice: Youth perspectives on digital technologies and urban transformations	2021	Smart Spaces and Places	taylorfrancis.com	8	17.25	23	3
9	60	I Nastjuk, S Trang, El Papageorgiou	Smart cities and smart governance models for future cities: Current research and future directions	2022	Electronic Markets	Springer	9	20	20	3
10	148	Y Kaluarachchi	Implementing data-driven <i>Smart City</i> applications for future cities	2022	Smart Cities	mdpi.com	10	49.33	148	1

11	58	M Wawer, K Grzesiuk, D Jegorow	Smart mobility in a <i>Smart City</i> in the context of Generation Z sustainability, use of ICT, and participation	2022	Energies	researchgate.net	11	19.33	19	3
12	12	H Tekin, I Dikmen	Inclusive smart cities: An exploratory study on the London <i>Smart City</i> strategy	2024	Buildings	mdpi.com	12	12	6	2
13	65	I Calzada, M Pérez-Batlle...	People-centered smart cities: An exploratory action research on the cities' coalition for digital rights	2023	Journal of Urban ...	Taylor & Francis	13	32.5	22	3
14	55	K Sriwisathiyakun, C Dhamanitayakul	Enhancing <i>Digital Literacy</i> with an intelligent conversational agent for senior citizens in Thailand	2022	Education and Information ...	Springer	14	18.33	28	2
15	130	MJN Han, MJ Kim	A critical review of the <i>Smart City</i> in relation to citizen adoption towards sustainable smart living	2021	Habitat International	Elsevier	15	32.5	65	2
16	88	RD Kusumastuti, N Nurmala, J Rouli...	Analyzing the factors that influence the seeking and sharing of information on the <i>Smart City</i> digital platform: Empirical evidence from Indonesia	2022	Technology in Society	Elsevier	16	29.33	22	4
17	160	M Hassankhani, M Alidadi, A Sharifi...	<i>Smart City</i> and crisis management: Lessons for the COVID-19 pandemic	2021	International Journal of ...	mdpi.com	17	40	40	4
18	57	SI Syalianda, RD Kusumastuti	Implementation of <i>Smart City</i> concept: A case of Jakarta <i>Smart City</i> , Indonesia	2021	IOP Conference Series: Earth ...	iopscience.iop.org	18	14.25	29	2
19	103	R Wolniak, K Stecuła	Artificial Intelligence in Smart Cities Applications, Barriers, and Future Directions: A Review	2024	Smart Cities	mdpi.com	19	103	52	2
20	55	I Calzada	The right to have digital rights in smart cities	2021	Sustainability	mdpi.com	20	13.75	55	1

Table 2. Top 20 Most Frequently Occurring Terms in the Articles

term	occurrences	relevance score
<i>Digital Literacy</i>	205	0.8347
lot	110	0.7874
Internet	107	0.868
Smart person	70	1.7801
Smart home	51	0.9885
Education	49	0.3772
Industry	43	0.4788
Device	41	0.4368
Skill	39	1.2983
Digital twin	38	1.0567
Literacy	38	1.6635
Architecture	34	0.6624
Covid	33	1.2514
Smart governance	32	2.2926
Smart grid	32	1.1661
Smart mobility	32	2.4694
Smart environment	27	2.2258
Sustainability	27	0.5893
Community	26	0.2651
Digital technology	26	0.989

MAPPING RESULTS USING THE NETWORK VISUALIZATION METHOD



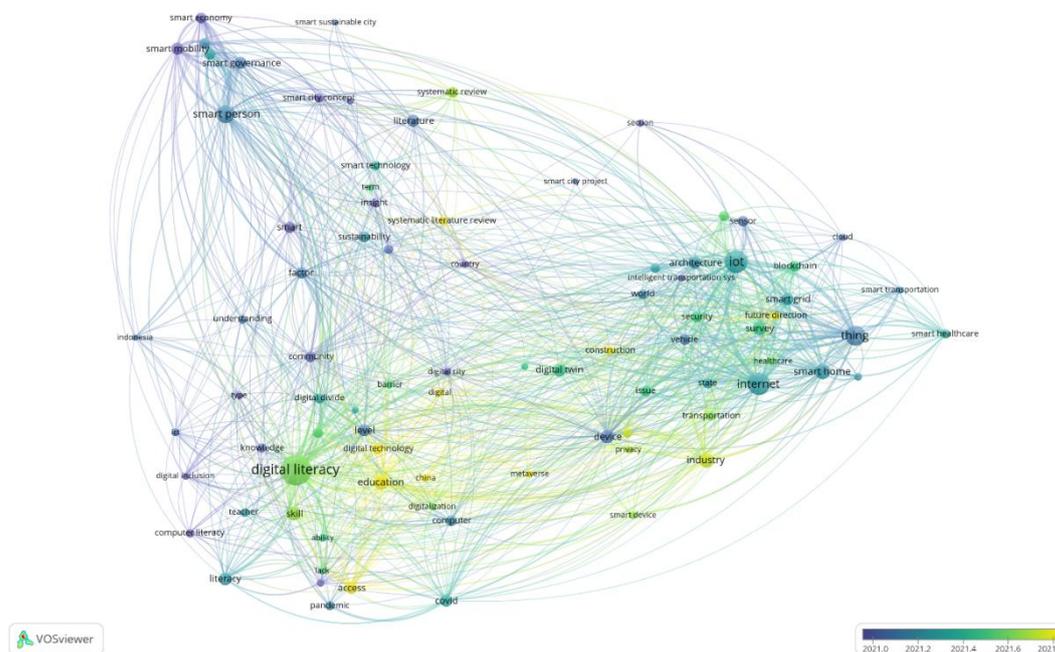
Gambar 1. Hasil Pemetaan dengan metode tampilan Network Visualization

Cluster 1 consists of 33 keywords representing the themes of *Digital Literacy*, digital transformation, and *Smart City* development. Terms such as *digital inclusion*, *digital technology*, *digital transformation*, and *digital divide* indicate a focus on equitable access to technology. The diversity of digital capabilities is reflected in words like *access*, *skill*, *ability*, and *knowledge*, which are influenced by education and infrastructure. The presence of terms such as *education*, *teacher*, and *understanding* highlights the role of education in strengthening digital literacy. The appearance of keywords like *covid*, *pandemic*, and *metaverse* illustrates the acceleration of digitalization and technological evolution. The terms *digital city*, *intelligent city*, and *ICT* emphasize the connection between digital literacy and the smart city concept. Meanwhile, geographic references such as *Indonesia* and *China* indicate the regional contexts of the studies. Overall, this cluster highlights the critical role of digital literacy in achieving inclusive and sustainable digital transformation.

Cluster 2 contains 31 keywords emphasizing infrastructure technology, intelligent systems, and the digitalization of urban and industrial life. Terms like *smart building*, *smart home*, *smart grid*, *IoT*, *cloud computing*, and *sensor* depict the implementation of intelligence across various sectors. The presence of words such as *architecture*, *digital twin*, and *energy* indicates the link between technology and physical development. *Blockchain* and *security* underscore the importance of data protection within the smart city ecosystem. Keywords such as *healthcare*, *industry*, *future direction*, and *survey* reflect the broad scope of technology from service delivery to future development paths. The terms *intelligent transportation* and *vehicle* further emphasize the significance of smart mobility. This cluster illustrates the role of integrated technologies in shaping efficient and sustainable cities of the future.

Cluster 3, with 21 keywords, focuses on the conceptual and theoretical aspects of *Smart City* development. Terms like *Smart City concept*, *development*, *project*, and *smart sustainable city* suggest an emphasis on the definition and process of smart city building. Dimensions such as *smart governance*, *mobility*, *economy*, *technology*, and *living* reflect the breadth of elements involved. The inclusion of *sustainability* highlights the importance of balancing social, economic, and environmental aspects. The keyword *barrier* refers to the challenges of implementation, while *systematic literature review*, *insight*, and *term* indicate an academic, literature-based approach. This cluster represents a theoretical framework for understanding Smart Cities from a multidimensional and cross-national perspective.

MAPPING RESULTS USING THE OVERLAY VISUALIZATION METHOD



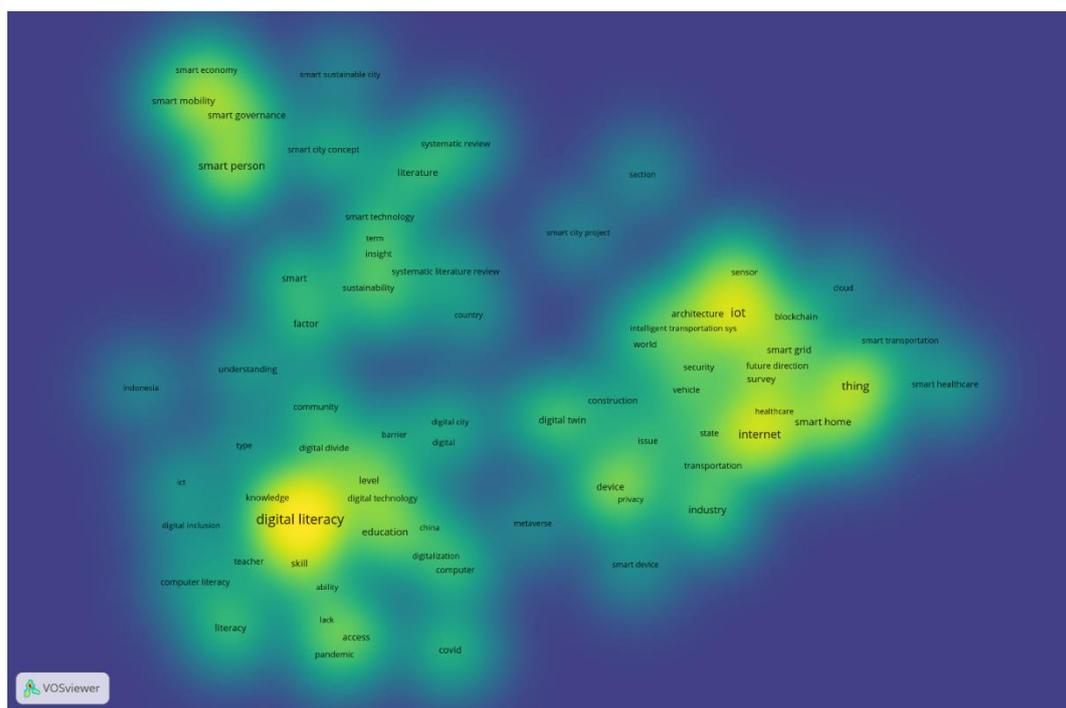
Gambar 2. Hasil Pemetaan dengan metode tampilan Overlay Visualization

The *Overlay Visualization* image generated by VOSviewer illustrates the temporal relationship and development of keywords in the literature on *Smart City* and *Digital Literacy*. Purple indicates earlier keyword appearances (around 2021.0), while green to yellow represents more recent terms (up to 2021.8). Keywords such as *smart governance*, *smart economy*, *smart mobility*, and *sustainability* appeared earlier, reflecting the initial conceptual focus of research on smart cities.

Subsequently, terms like *IoT*, *device*, *internet*, *industry*, and *security* appear in green, signaling a shift toward more practical and technical implementation issues. Meanwhile, keywords such as *Digital Literacy*, *education*, *access*, *privacy*, *pandemic*, and *metaverse*, which appear in yellow, indicate the most recent attention to social, educational, and societal digital transformation aspects, including emerging technological trends.

As stated by Al Husaeni & Nandiyanto (2022), each term is represented by a colored circle, with the size of the circle reflecting the frequency of the term's occurrence the more frequent the appearance, the larger the circle. This visualization illustrates the shift in focus from theoretical understanding to technological implementation and societal readiness for an inclusive digital era.

MAPPING RESULTS USING THE DENSITY VISUALIZATION METHOD



Gambar 3. Hasil Pemetaan dengan metode tampilan Density Visualization

The *Density Visualization* generated by VOSviewer displays the intensity of keyword occurrences within the literature related to *Smart City* and *Digital Literacy*. Bright yellow areas indicate high density, while green to dark blue areas signify moderate to low density. *Digital Literacy* appears as the central point with the highest density, indicating that it is the most frequently discussed topic.

Keywords such as *education*, *skill*, *knowledge*, *access*, *digital technology*, and *digital divide* suggest its close relationship with education, individual capabilities, and access to technology. Another concentration center is visible around *internet*, *IoT*, *smart home*, and *industry*, highlighting a focus on digital connectivity and smart home technologies. Terms such as *smart grid*, *sensor*, and *security* reinforce the importance of technological infrastructure and data security in smart cities.

Additionally, keywords like *smart person*, *smart governance*, *smart economy*, and *smart mobility* reflect the relevance of social, economic, and mobility aspects. Meanwhile, terms such as *blockchain*, *cloud*, *systematic literature review*, and *smart healthcare* appear in darker areas, indicating these topics are still emerging.

This visualization reveals that *Digital Literacy* and the integration of smart technologies are primary focal points in the literature, while other themes are gradually gaining attention as part of the evolving discourse.

CONCLUSION AND RECOMMENDATIONS

Based on the visual analysis using *Network*, *Overlay*, and *Density Visualization* methods, research on *Smart City* and *Digital Literacy* demonstrates dynamic and multidimensional development. The *Overlay Visualization* reveals that the initial focus was on fundamental Smart

City concepts and sustainability, which later evolved toward the application of technologies such as *IoT*, *smart grid*, and *smart home*, as well as more recent issues like *Digital Literacy*, the digital divide, and the impact of the pandemic. The *Density Visualization* shows that *Digital Literacy* is the densest keyword, indicating its critical role in enabling individuals to engage effectively in smart city implementation.

The cluster analysis reinforces these findings by categorizing the themes into three groups: *Digital Literacy* and access to technology (Cluster 1), intelligent infrastructure technologies (Cluster 2), and conceptual and governance aspects of *Smart City* (Cluster 3). The analysis of author collaboration and dominant keywords highlights an active global academic community, although cross-country collaborations remain dominated by developed countries. Keywords such as *Digital Literacy*, *Smart City*, *ICT*, and *governance* reflect strong contributions in the fields of technology and policy.

Therefore, future research should emphasize interdisciplinary approaches that integrate technological, social, and policy dimensions. It is essential to deepen the exploration of societal readiness for digital transformation, particularly in terms of digital literacy, access disparities, and issues of privacy and data security. Furthermore, the implementation of *Smart City* initiatives in developing countries such as Indonesia must consider socio-economic and educational contexts. Region-based or local case studies also hold potential to support the formulation of inclusive and sustainable *Smart City* policies.

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