

COMMUNITY EDUCATION AND ITS ROLE IN PROMOTING SMART CITIES WITHIN A RAPIDLY CHANGING TECHNOLOGICAL ENVIRONMENT

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Abstract

This study explores the role of community education in smart city development within the Indonesian context. The purpose is to understand urban residents' perceptions, attitudes, and barriers toward technology and smart city initiatives and evaluate the effectiveness of current community education programs. A cross-sectional research design was employed, involving surveys and interviews with residents from cities participating in Indonesia's 'Towards 100 Smart Cities' initiative. Thematic and statistical analyses were conducted to analyze the data collected. The findings reveal a mix of optimism and concerns among respondents regarding technology and smart city initiatives, highlighting the importance of addressing privacy, security, and inclusivity issues. While current community education programs effectively raise awareness about smart city concepts, gaps in accessibility and inclusivity persist, suggesting the need for targeted interventions. The study's novelty lies in its contextualized approach to understanding smart city development within Indonesia's diverse urban landscape. It provides practical insights for policymakers and urban planners, emphasizing the importance of community education in promoting inclusive and participatory smart city development. The study contributes to the growing literature on smart city development by offering valuable insights and recommendations for advancing sustainable and equitable urban development in Indonesia and beyond.

Keywords: Community Education; Inclusivity; Perceptions; Urban Development; Smart City

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INTRODUCTION

In recent years, the concept of smart cities has experienced a remarkable surge in popularity, primarily in response to the formidable challenges posed by the rapid pace of urbanization and the continuous evolution of technology within urban areas. This surge reflects a growing recognition of the imperative to address pressing urban issues such as traffic congestion, environmental degradation, and inadequate infrastructure, all exacerbated by the relentless growth of cities worldwide.

Smart cities represent a proactive approach to tackling these challenges by leveraging cutting-edge technology and data-driven solutions to enhance urban life. For instance, according to a report by the McKinsey Global Institute (McKinsey & Company, 2018), by 2030, smart city technologies could save up to 30% of water consumption, reduce commute times by 15-20%, and cut greenhouse gas emissions by 15%. By harnessing the power of technology, smart cities aim to optimize resource allocation, streamline services, and improve overall urban efficiency. Moreover, they strive to foster sustainability by minimizing environmental impact and promoting eco-friendly practices. For example, Barcelona's

implementation of smart city technologies has reduced energy consumption by 30% and greenhouse gas emissions by 23% (Albino et al., 2015).

Amidst the fervor surrounding technological innovation, it is imperative to acknowledge that the success of smart city initiatives relies not only on the adoption of advanced technologies but also on the active participation and empowerment of the community. While technological advancements hold significant promise, their true impact can only be fully realized when combined with meaningful engagement from residents. This necessitates a departure from the traditional top-down approach to urban development towards a model prioritizing grassroots involvement and collaboration.

Urbanization, characterized by the increasing concentration of people in urban areas, is a global trend with profound implications for society, economy, and the environment. Currently, more than half of the world's population resides in cities, and this proportion is projected to rise to 68% by 2050, according to the United Nations (UN) (United Nations, 2017). This rapid urban expansion poses many challenges that impact the quality of life for urban residents and strain the resources and infrastructure of cities worldwide.

One of the primary challenges associated with urbanization is traffic congestion, as the influx of people into cities exacerbates existing transportation issues. Congested roads lead to increased commute times, air pollution, and decreased productivity, ultimately diminishing the overall livability of urban environments. For instance, in 2019, traffic congestion cost the United States approximately \$88 billion in wasted time and fuel, according to a report by INRIX (INRIX, 2022).

It has also been found that rapid urbanization contributes to environmental degradation, as cities consume vast natural resources and produce significant waste and pollution. Urban sprawl often encroaches upon natural habitats, leading to habitat loss and fragmentation, biodiversity loss, and increased vulnerability to natural disasters. According to the World Bank, urban areas generate around 70% of global greenhouse gas emissions, highlighting the environmental impact of urbanization (World Bank, 2023).

Inadequate infrastructure is another critical challenge posed by urbanization. Many cities struggle to provide their growing populations with essential services such as clean water, sanitation, healthcare, and affordable housing. Insufficient infrastructure compromises the well-being of urban residents and hinders economic growth and development. For example, a report by the World Economic Forum estimated that the world faces an annual infrastructure investment gap of \$15 trillion by 2040 (World Economic Forum, 2020).

Rapid urbanization often exacerbates social inequality, as marginalized populations face barriers to accessing essential services and opportunities. Economic disparities, unequal access to education and healthcare, and spatial segregation further exacerbate social divides within urban areas, leading to social unrest and instability. According to the United Nations Development Programme (UNDP), income inequality within cities is rising, with the richest 10% of urban residents earning up to 40% of total income (United Nations Development Programme, 2019).

Smart cities have emerged as a holistic solution to these multifaceted challenges. Smart cities leverage digital technologies, data analytics, and innovative approaches to address urban problems and improve the quality of life for residents. By integrating technology into various aspects of urban governance and infrastructure, smart cities aim to enhance efficiency, sustainability, and resilience. Smart transportation systems use real-time data to optimize traffic flow, reduce congestion, and improve public transportation services. Smart energy grids and building management systems enhance energy efficiency and reduce carbon emissions, contributing to environmental sustainability. Moreover, smart city initiatives emphasize citizen engagement and participation, empowering residents to actively contribute to decision-making processes and co-create solutions to urban challenges.

The smart city concept emphasizes citizen-centric approaches to urban development, highlighting the active involvement of residents in decision-making processes and service delivery (Batty et al., 2012). This participatory model has been shown to foster greater civic engagement, social cohesion, and inclusivity within urban communities (Harrison & Donnelly, 2011). A case in point is the Amsterdam Smart City project, launched in 2009, which became a global example of a citizen-centric urban development program. Through various initiatives, such as the "Living Lab" program, residents actively co-create innovative solutions to urban challenges (De Lange & De Waal, 2017). This bottom-up approach has led to the implementation of numerous successful projects, including community-led renewable energy initiatives, smart mobility solutions, and collaborative urban planning efforts.

Understanding the role of community education becomes paramount in promoting smart city initiatives and ensuring their successful implementation within rapidly evolving technological environments. Research indicates that informed and empowered citizens are more likely to embrace smart technologies and actively participate in shaping their urban environment (Albino et al., 2015). Community education initiatives can bridge the digital divide, promote digital literacy, and empower individuals to leverage technology by providing residents with the necessary knowledge and skills.

Furthermore, community education serves as a critical mechanism for addressing social disparities and advancing social inclusivity within the framework of smart cities. By ensuring that education and training opportunities are accessible to all community members, irrespective of their socioeconomic status or background, smart city initiatives can help bridge the gap in technology adoption and ensure that the benefits of urban innovation are distributed equitably (Nam & Pardo, 2011).

In Indonesia, the largest archipelago globally, urbanization poses many challenges, including rapid population growth, economic expansion, and cultural diversity. With projections indicating a significant increase in the urban population, reaching 68% by 2030, according to the World Bank (World Bank, 2020), the Indonesian government has embarked on ambitious projects like constructing a new capital city. However, the success of these urban development endeavors relies not only on infrastructural investments but also on the integration of smart city principles and active community engagement.

Despite strides in implementing digital solutions to improve urban governance, research indicates a pressing need for heightened community involvement and education in Indonesia. While technology adoption is on the rise, the inclusivity and sustainability of smart city initiatives in Indonesian urban areas depend heavily on the active participation of residents. Recognizing the pivotal role of community education is essential for advancing smart city development and effectively addressing urban challenges. As Indonesia begins establishing a new capital, it must prioritize inclusive strategies that empower communities and promote sustainable urban growth.

This study delves into the intricate dynamics surrounding the pivotal role of community education in fostering the development and successful implementation of smart city initiatives. It seeks to unravel the multifaceted ways community engagement and empowerment through education contribute to the effectiveness and sustainability of smart city projects. The research is spurred by a deep-seated recognition that the success of smart cities hinges on the active involvement of citizens in decision-making processes and the collaborative co-creation of innovative urban solutions, as articulated by Caragliu et al. (Caragliu et al., 2011).

In this regard, the present study endeavors to shed light on the profound impact of community education in nurturing sustainability and resilience within smart city development. It aims to elucidate how educational programs can catalyze behavioral shifts towards responsible consumption and production patterns, thereby addressing pressing environmental, social, and economic challenges, as highlighted by Nam & Pardo (Nam & Pardo, 2011).

Furthermore, the research seeks to delve into the empowerment of individuals with the requisite knowledge and skills to engage with smart city technologies and initiatives meaningfully. It is driven by a nuanced understanding that in an era characterized by escalating digital reliance, citizens must comprehensively understand these technologies and their implications for urban living (Albino et al., 2015). Raising awareness of sustainable practices and promoting active civic participation, community education emerges as a transformative force, empowering residents to actively shape their cities' trajectories by fostering digital literacy.

At its core, the primary objective of this research is to unravel the specific role of community education in propelling smart city development within the Indonesian context. It aspires to comprehensively evaluate the current landscape of community education initiatives in Indonesian urban areas, discerning their impact on the advancement of smart cities. Additionally, the study aims to gauge the awareness and understanding of smart city concepts among Indonesian residents, delving into their perceptions, attitudes, and receptiveness towards smart city initiatives. Furthermore, the research explores the primary challenges and opportunities in integrating community education into smart city strategies in Indonesia, unraveling the intricate interplay between socio-cultural, economic, and institutional factors.

The study will adopt a multi-faceted approach to achieve these ambitious objectives, combining qualitative and quantitative research methods. It will employ a mix of surveys, interviews, and case studies to gather rich, nuanced insights into the complex dynamics. Through a rigorous analysis of the findings, the research aims to generate actionable recommendations and insights that can inform policy-making and practice, driving towards a more inclusive, sustainable, and equitable urban future in Indonesia and beyond.

literature review

Smart cities represent a paradigm shift in urban development, integrating technology, data, and citizen engagement to address the complex challenges of modern urbanization. This literature review explores the foundational concepts of smart cities, the influence of technology on urban environments, the significance of community education in urban development, and case studies highlighting successful implementations of community education in smart cities.

Understanding Smart Cities and Their Components

Smart cities leverage digital technologies and data analytics to optimize urban systems and improve the quality of life for residents (Caragliu et al., 2011). Key components include smart governance, infrastructure, mobility, environment, economy, and people (Giffinger et al., 2007). Smart governance involves data-driven decision-making processes to enhance public service delivery and policy formulation (Appio et al., 2019). Infrastructure encompasses smart buildings, utilities, and transportation systems designed for efficiency and sustainability (Albino et al., 2015). Mobility integrates transportation modes and optimizes traffic flow through technology (Nam & Pardo, 2011). Environmental sustainability involves monitoring and managing resources to minimize ecological impact (Albino et al., 2015). Smart economy initiatives aim to foster innovation and entrepreneurship (Caragliu et al., 2009). Lastly, people-centered approaches prioritize citizen engagement and empowerment (Appio et al., 2019).

The Role of Technology in Shaping Urban Environments

Technology catalyzes transforming urban environments, enabling cities to become more efficient, resilient, and inclusive. Advances in the Internet of Things (IoT), Artificial Intelligence (AI), and Big Data analytics have revolutionized urban planning and management (Hollands, 2008). IoT sensors collect real-time data on city life, from traffic flow to air quality, facilitating informed decision-making (Zanella et al., 2014). AI algorithms analyze vast datasets to optimize resource allocation, predict urban trends, and improve service delivery (Bibri & Krogstie, 2017). Big Data analytics extract actionable insights from diverse sources, empowering cities to address complex urban challenges (Chourabi et al., 2012). Additionally, technology-enabled platforms promote citizen participation, fostering a culture of collaboration and innovation (Townsend, 2013).

Community Education and Its Significance in Urban Development

Community education plays a pivotal role in fostering inclusive and sustainable urban development. By raising awareness, building capacity, and fostering collaboration, education empowers citizens to actively participate in shaping their urban environments (Nam & Pardo, 2011). In smart cities, community education encompasses initiatives to enhance digital literacy, promote civic engagement, and foster social inclusion among residents (Hollands, 2008). Digital literacy programs equip residents with the skills to engage with technology and access online services (Komninos et al., 2021). Environmental education initiatives promote sustainable behaviors and encourage stewardship of natural resources (Merenlender et al., 2016). Civic engagement workshops provide platforms for dialogue and deliberation, enabling citizens to contribute to decision-making processes (Davies et al., 2012). By providing educational programs, workshops, and outreach activities, cities can effectively empower citizens with the knowledge, skills, and opportunities to participate in smart city initiatives. Furthermore, community education initiatives strengthen social cohesion and resilience, enhancing the overall quality of life in urban areas (Auckland & Kilpatrick, 2021; Cinderby et al., 2016).

Moreover, educational programs address digital inclusion and equity challenges by providing tailored resources and support services to marginalized communities, such as seniors, immigrants, and low-income families (Harrison & Donnelly, 2011). By promoting digital literacy and skills development, community education initiatives enable residents to access online services, participate in digital platforms, and engage in decision-making processes, thereby fostering greater social cohesion and democratic governance in urban communities.

Case Studies on Successful Implementation of Community Education in Smart Cities

Several case studies demonstrate the effectiveness of community education in advancing smart city objectives. In Barcelona, Spain, the "Digital City" program offers training workshops and support services to promote digital inclusion among residents (Mora et al., 2019). The initiative has empowered marginalized communities through partnerships with local organizations to access online resources and participate in civic life. In Singapore, the "Smart Nation" initiative integrates community learning hubs into public spaces, providing residents hands-on experience with emerging technologies (Leong & Lee, 2021). These hubs serve as incubators for innovation, fostering collaboration between citizens, businesses, and government agencies. In Seoul, South Korea, the "Sharing City" initiative promotes a culture of sharing and collaboration through community-led projects and educational programs (Bernardi & Diamantini, 2018; Fedorenko, 2017). By harnessing the collective intelligence of residents, the initiative has generated innovative solutions to urban challenges while strengthening social bonds.

In the context of Indonesia, one notable example is the Smart City Program in Jakarta, Indonesia's capital city. Launched in 2014, this initiative aims to enhance governance, public services, and residents' quality of life through technology integration (Adnan et al., 2021). A key component of the Jakarta Smart City initiative is the Qlue mobile application, allowing citizens to report urban issues directly to government agencies (Zhu & Alamsyah, 2022). Qlue facilitates real-time communication between citizens and authorities, leading to prompt responses and improved service transparency (Khan & Johnson, 2020). The app empowers residents to engage actively in urban governance, enhancing transparency and accountability in municipal administration.

Similarly, Bandung, known as the "Creative City," fosters innovation and entrepreneurship through initiatives like the Bandung Digital Valley (Arfiansyah & Han, 2020). This collaborative workspace and incubator provide aspiring entrepreneurs with training and networking opportunities, driving economic growth and positioning Bandung as a hub for technology and creativity (Rofaida et al., 2020). In Surabaya, Indonesia's second-largest city, the Smart City Program focuses on technology integration to improve public services and governance (Herdiyanti et al., 2019). The Surabaya Digital Platform integrates data for informed decision-making and citizen engagement, resulting in more efficient service delivery and enhanced social cohesion. These case studies demonstrate the successful implementation of community education in Indonesian smart cities, highlighting the importance of technology-enabled citizen participation in urban development.

Despite the global interest and investment in smart city initiatives, a crucial gap persists in understanding how community education facilitates their successful implementation and sustainability. While technological advancements offer opportunities for urban improvement, the effectiveness of smart city initiatives hinges on citizen engagement. However, research on how community education empowers residents in rapidly changing technological environments is limited, especially in the Indonesian context. Existing studies often overlook diverse demographic needs, potentially widening digital divides. Marginalized groups face barriers to accessing and benefiting from smart city technologies, exacerbating inequalities. Without targeted educational interventions, smart city initiatives risk reinforcing disparities. While some cities implement community education, there's inadequate evaluation of their effectiveness. Empirical research is needed to address digital inclusion, evaluate outcomes, and inform evidence-based policy and practice in smart city development, especially in emerging economies.

METHODOLOGY

Type & Approach

This study employed a cross-sectional research design, aiming to capture a snapshot of the current state of community education initiatives and their correlation with smart city development in Indonesia. Cross-sectional research allows for data collection from diverse respondents across different geographical locations and demographic groups within a specific timeframe, providing a comprehensive understanding of the research topic (Babbie, 2020; Creswell & Creswell, 2017).

This approach is particularly suitable for capturing a broad overview of the status of community education initiatives and their relationship with smart city development across different regions and population segments in Indonesia. It enables researchers to examine the phenomenon at a specific time, offering insights into the prevailing conditions and trends.

The selection of a cross-sectional design aligns with the research objective of assessing the current landscape of community education initiatives in the context of smart city development. Moreover, the cross-sectional approach facilitates the identification of potential disparities or variations in community education practices across different demographic groups and geographic regions. This comprehensive view enables researchers to generate insights representative of Indonesia's diverse population of urban residents.

Data & Data Sources

A cross-sectional sampling approach was adopted to gather insights into the research topic, focusing on Indonesian cities identified in the 'Towards 100 Smart Cities' initiative by Indonesia's Ministry of Communication and Information (Safitri & Dyah Kusumastuti, 2020; Shafiullah et al., 2022). This initiative aims to promote the development of smart cities across Indonesia, making the selected cities pertinent to the study's objectives. Cities included in the initiative, such as Bekasi, Cirebon, Bogor, Bandung, and Tangerang (Pratama, 2022), were chosen as primary locations for data collection due to their active involvement in smart city initiatives.

Consultation with the authorities of these cities ensured their awareness and support for engaging their residents in the study, facilitating access to relevant information and resources (Babbie, 2020). This collaboration enhanced the credibility and reliability of the data collected, as it was obtained with the cooperation of local governance structures actively involved in smart city development efforts.

To ensure diverse participation, efforts were made to recruit respondents across various demographic groups, including age, gender, occupation, educational background, and geographic location. This approach aimed to capture a wide range of perspectives and experiences related to community education and smart city initiatives, enriching the depth and breadth of the study's findings.

Participants were recruited through multiple channels, including community organizations, educational institutions, and social media platforms (Creswell & Creswell, 2017). This multi-faceted recruitment strategy helped reach a diverse pool of respondents and ensured broader representation within the sample.

Additionally, questionnaires were distributed randomly among residents of the selected cities, totaling 3800 invitations sent to individuals of diverse demographics. Over six months, 2893 individuals responded, with 1938 fully completed questionnaires meeting the study's eligibility criteria. Sample analysis indicated representation across various categories, reflecting the demographic diversity of the Indonesian urban population.

Table 1. Summarized Demographic Profile of Respondents

	Group Characteristics	Number of Respondents	Percentage (%)
Age	<25	523	27
	25-49	930	48
	50-69	271	14
	70+	213	11
Sex	Female	959	49.5
	Male	979	50.5
Occupation	Private-sector Employed	503	26
	Public-sector employed	406	21
	Self-employed (formal)	290	15
	Self-employed (non-formal)	542	28
	Student	193	10
Ethnicity/Region of origin	Indonesia	1608	83
	China	122	6.3
	Middle-East	27	1.4
	Africa	13	0.7
	Southeast Asia	96	5
	Korea	38	2
	Japan	11	0.6
	'The West' (Europe, America, Australia)	19	1

Data Collection Techniques

Data collection for this study involved surveys and interviews to gather insights from urban residents in various Indonesian cities. Combining these techniques allowed for a comprehensive exploration of respondents' awareness, attitudes, and perceptions regarding smart city concepts and community education initiatives (Creswell & Creswell, 2017; Dillman et al., 2014).

The survey instrument utilized structured questions to systematically assess respondents' knowledge, opinions, and beliefs about smart city development and community education initiatives. These questions were carefully crafted to cover various topics, including awareness of smart city concepts, involvement in community education initiatives, and perceptions of the impact of urban development efforts.

Additionally, semi-structured interviews were conducted with key stakeholders, including government officials, community leaders, and representatives from educational institutions. These interviews provided an opportunity to gather more in-depth insights and perspectives, allowing for a nuanced understanding of the complex factors influencing smart city development and community education practices.

The questionnaire for data collection incorporated constructs of awareness, attitudes, and perceptions to evaluate respondents' comprehension, viewpoints, and subjective interpretations regarding the smart city concept. Each construct served a specific purpose in eliciting information from participants:

- Awareness: This construct aimed to gauge the extent to which respondents were knowledgeable or informed about smart city initiatives and community education programs. Questions focused on respondents' familiarity with key terms, events, or developments relevant to the research topic, such as their awareness of the concept of 'smart cities' and their exposure to community education initiatives in their city.
- Attitudes: Questions related to attitudes aimed to uncover respondents' sentiments, opinions, or predispositions toward community education programs and smart city initiatives. Researchers gained insights into these initiatives' perceived value and impact by assessing respondents' viewpoints on the effectiveness of community education programs and the importance of residents' active involvement in smart city initiatives.
- Perceptions: This construct explored respondents' subjective interpretations or beliefs regarding smart city phenomena and community education efforts. Questions aimed to uncover participants' perceptions of the impact of smart city development on their overall quality of life and their beliefs regarding the role of community education in shaping urban development outcomes.

Data Analysis Techniques

The data analysis techniques employed in this study encompassed qualitative and quantitative approaches, aiming to provide a comprehensive understanding of the relationship between community education initiatives and smart city development in Indonesia.

Thematic analysis was utilized to examine the qualitative data collected through interviews (Braun & Clarke, 2006). This involved a systematic review of interview transcripts to identify recurring patterns, themes, and trends related to community education and smart city development. Researchers could organize these themes into coherent categories through careful coding and analysis, facilitating interpretation and comparison. The thematic analysis enabled the researchers to uncover nuanced perspectives and understand the complex interconnections between community education initiatives and the broader context of smart city development.

In addition to thematic analysis, statistical techniques were applied to analyze the quantitative survey data. Descriptive statistics, including frequencies, percentages, and measures of central tendency, were calculated to summarize respondents' demographic characteristics and survey responses (Field, 2013). These statistics provided valuable insights into the distribution and characteristics of the study population, allowing researchers to understand the demographic profile of respondents and the prevalence of different attitudes and perceptions related to smart city concepts and community education initiatives.

Furthermore, inferential statistics, such as chi-square tests or regression analysis, were employed to explore relationships between variables and uncover potential associations or correlations. These analyses enabled researchers to examine the impact of various factors, such as demographic variables or levels of awareness, on attitudes toward community education and smart city development. By applying statistical techniques, researchers were able to derive meaningful insights from the quantitative data and identify significant trends or patterns that could inform policy and practice in the context of smart city initiatives.

Throughout the research process, ethical considerations were paramount to ensure the rights and welfare of participants. Informed consent was obtained from all participants before their involvement in the study, and they were assured of confidentiality and anonymity. The research adhered to ethical guidelines outlined by relevant institutional review boards and ethical committees to safeguard participants' rights and maintain the integrity of the research process (Denzin & Lincoln, 2011).

RESULTS AND DISCUSSION

Results

The data collected yielded valuable insights into various aspects of smart city development and community education initiatives in Indonesia. A diverse range of respondents participated, providing a comprehensive view of urban residents' perceptions, attitudes, and awareness regarding smart city concepts and community engagement.

Smart City Initiatives

- a) Bekasi

Bekasi, situated in the heart of West Java, is an emblem of Indonesia's urban dynamism and economic vitality. With a population exceeding 3,8 million inhabitants (World Population Review, 2024), Bekasi emerges as the largest city in the province, teeming with diversity, energy, and ambition. Its strategic location, nestled in the outskirts of Jakarta, positions it as a key player in the region's economic landscape, attracting businesses, industries, and residents seeking opportunities for growth and prosperity.

The city's economic prowess is underscored by its robust manufacturing sector, encompassing various industries, including automotive, electronics, and textiles. Bekasi's industrial parks and manufacturing zones are incubators for innovation and production, contributing significantly to the region's GDP and employment (Investor Daily, 2021). Moreover, its strategic connectivity to major transportation networks and ports facilitates seamless trade and commerce, further bolstering its economic significance.

Bekasi's journey towards smart city transformation is driven by a strategic vision to harness technology and innovation to address the complex challenges of rapid urbanization and population growth. At the forefront of these initiatives is the Smart Traffic Management System (TMS), a groundbreaking project to tackle the pervasive issue of traffic congestion plaguing the city's thoroughfares.

The TMS employs state-of-the-art technologies, including traffic sensors, surveillance cameras, and advanced data analytics, to monitor traffic flow, detect congestion hotspots, and optimize signal timings in real-time. This data-driven approach has yielded tangible results, with Bekasi witnessing a remarkable reduction in travel times on key arterial roads, alleviating traffic woes and enhancing the efficiency of transportation networks.

In addition to traffic management, Bekasi has prioritized public safety and security as integral components of its smart city agenda. The city's extensive network of closed-circuit television (CCTV) cameras, strategically deployed across public spaces, residential neighborhoods, and commercial districts, is a vigilant guardian against criminal activities and emergencies. This robust surveillance infrastructure has deterred criminal behavior and facilitated swift responses to incidents, leading to a decrease in crime rates since its implementation.

Bekasi's smart city initiatives epitomize a holistic approach to urban development that transcends technological innovation to encompass economic prosperity, social well-being, and environmental sustainability. By leveraging technology to enhance transportation efficiency, improve public safety, and promote economic growth, the city is poised to unlock new opportunities for progress and prosperity.

Moreover, Bekasi's emphasis on data-driven decision-making and citizen-centric governance underscores its commitment to transparency, accountability, and inclusivity. Through initiatives empowering citizens, fostering collaboration, and promoting civic engagement, Bekasi aspires to cultivate a vibrant and resilient community thriving in the digital age.

As Bekasi continues its journey towards smart city excellence, its experiences and insights serve as valuable lessons for cities worldwide grappling with similar urban challenges. Bekasi paves the way for a brighter, more sustainable future for generations to come by embracing innovation, change, and its people's aspirations.

b) Cirebon

Cirebon, nestled along the northern coast of Java, boasts a rich tapestry of cultural heritage, architectural splendor, and historical significance. With a population surpassing 336,956 inhabitants, the city serves as a bustling hub of trade, commerce, and cultural exchange, embodying the essence of Indonesia's diverse heritage (World Population Review, 2024). However, rapid urbanization and population growth have strained the city's infrastructure, necessitating innovative solutions to navigate the complexities of modern urban life.

Cirebon has embarked on a transformative journey toward becoming a smart city in response to the challenges posed by urbanization and technological advancement. At the forefront of this endeavor is the Cirebon Digital City program, a comprehensive initiative aimed at harnessing digital technologies to enhance governance, service delivery, and quality of life for residents.

One of the flagship projects under the Cirebon Digital City program is establishing an Integrated Command Center (ICC) equipped with state-of-the-art technology and real-time data analytics capabilities. The ICC serves as the nerve center for city operations, enabling authorities to monitor key metrics such as traffic flow, public safety incidents, and environmental conditions. By leveraging data-driven insights, city officials can proactively address issues, optimize resource allocation, and improve overall urban management efficiency.

In tandem with efforts to enhance urban governance, Cirebon is prioritizing smart transportation solutions to alleviate congestion and enhance mobility within the city. Intelligent transportation systems, including adaptive traffic signal

control, smart parking management, and real-time transit information, are being deployed to optimize traffic flow and provide commuters with seamless and efficient mobility options.

Moreover, Cirebon recognizes the importance of digital inclusion in fostering social equity and economic empowerment. The city has launched initiatives to bridge the digital divide by providing digital skills training, facilitating affordable internet access, and promoting digital literacy among residents, particularly in underserved communities. Cirebon aims to unlock opportunities for socio-economic advancement and promote inclusive growth by equipping citizens with the necessary digital competencies.

Cirebon's smart city initiatives underscore its commitment to leveraging technology as a catalyst for sustainable development and inclusive growth. The city is poised to enhance its resilience, efficiency, and livability in the face of urban challenges by embracing digital innovation across governance, transportation, and social sectors.

Furthermore, Cirebon's emphasis on digital inclusion reflects its dedication to ensuring that the benefits of smart city transformation are accessible to all segments of society. Through targeted interventions to empower citizens with digital skills and access to technology, Cirebon is laying the groundwork for a more equitable and prosperous future.

As Cirebon continues its journey towards smart city excellence, its experiences serve as a beacon of inspiration for cities worldwide grappling with similar urban complexities. Cirebon is charting a course toward a brighter, more sustainable urban future by embracing innovation, collaboration, and citizen-centric approaches.

c) Bogor

Bogor, affectionately known as the "City of Rain," is nestled amidst the picturesque landscapes of West Java, serving as a tranquil oasis amid the bustling urban sprawl of Jakarta. With a population exceeding 1,2 million inhabitants (World Population Review, 2024), Bogor balances its rich cultural heritage with a commitment to environmental conservation and sustainable development. Home to the renowned Bogor Botanical Gardens and prestigious academic institutions, the city attracts visitors and scholars alike, drawn to its lush greenery, temperate climate, and vibrant cultural scene.

Bogor's smart city initiatives epitomize its dedication to preserving its natural heritage and promoting sustainable urban development. At the forefront of these efforts is the Bogor Green City initiative, a holistic endeavor to enhance the city's green infrastructure, mitigate environmental degradation, and foster a high quality of life for its residents.

Central to the Bogor Green City initiative is creating green corridors, which connect networks of parks, gardens, and pedestrian pathways weaving through the urban fabric. These green corridors not only provide residents with accessible green spaces for recreation and leisure but also facilitate biodiversity conservation and ecological connectivity within the city.

In addition to green corridors, Bogor has prioritized integrating green infrastructure into its built environment to mitigate the impacts of urbanization on the natural ecosystem. Initiatives such as green roofs, vertical gardens, and permeable pavements are being implemented to enhance rainwater absorption, reduce surface runoff, and combat the urban heat island effect.

Furthermore, Bogor has implemented innovative waste management solutions to promote a circular economy and reduce its ecological footprint. The city's waste-to-energy projects, community-based recycling programs, and composting initiatives aim to minimize waste generation, divert recyclable materials from landfills, and harness renewable energy from organic waste.

Bogor's smart city initiatives reflect its proactive approach to addressing the environmental challenges of rapid urbanization and population growth. The city aims to preserve its natural beauty, enhance resilience to climate change, and improve the overall quality of life for its residents by prioritizing green infrastructure, waste management, and sustainable practices.

Moreover, Bogor's commitment to sustainability is a model for other cities grappling with similar urban challenges worldwide. As cities increasingly confront issues such as pollution, habitat loss, and climate change, Bogor's experiences offer valuable insights into the potential of smart city solutions to create more livable, resilient, and sustainable urban environments for future generations.

d) Bandung

Bandung, fondly dubbed the "Paris of Java," is a testament to the harmonious blend of tradition and modernity, culture and innovation. With a population exceeding 2.7 million inhabitants (World Population Review, 2024), Bandung thrives as the capital of West Java Province, attracting visitors with its vibrant arts scene, culinary delights, and academic

excellence. The city's strategic location amidst verdant mountains and fertile valleys has long inspired creativity and ingenuity, making it a hotspot for artists, entrepreneurs, and intellectuals alike.

Bandung's smart city initiatives exemplify its commitment to leveraging innovation and technology to foster economic growth, social inclusion, and sustainable development. At the core of these initiatives lies a vision to harness the city's creative potential and digital capabilities to address urban challenges and enhance the quality of life for its residents.

The Bandung Creative City initiative is a flagship endeavor to nurture creativity, innovation, and entrepreneurship within the city's vibrant ecosystem. Bandung seeks to cultivate a conducive environment for artists, designers, and technologists to collaborate, experiment, and thrive by establishing creative hubs, maker spaces, and innovation clusters. The initiative aims to propel Bandung onto the global stage as a hub for creative industries and cultural exchange by providing access to state-of-the-art facilities, mentorship programs, and funding opportunities.

In addition to fostering creativity, Bandung has embraced digital governance to enhance efficiency, transparency, and citizen engagement in public administration. The Bandung Smart Governance program leverages digital platforms, data analytics, and e-government solutions to modernize government services, streamline bureaucratic processes, and promote participatory decision-making. Bandung aims to build a more responsive and accountable governance framework that meets the evolving needs of its diverse population by digitizing administrative procedures, implementing open data initiatives, and engaging citizens through online platforms.

Bandung's smart city initiatives underscore its commitment to harnessing innovation, creativity, and technology as catalysts for urban development and prosperity. The city aims to unlock its full potential as a dynamic and inclusive metropolis by investing in creative industries, digital governance, and entrepreneurial ecosystems. Moreover, Bandung's experiences serve as a model for cities worldwide seeking to embrace the opportunities and challenges of the digital age, demonstrating the transformative power of smart city strategies in shaping more resilient, equitable, and sustainable urban futures.

e) Tangerang

Tangerang, strategically located in Banten Province and bordering Jakarta, has undergone rapid urbanization and economic development, emerging as a pivotal center of commerce, industry, and residential expansion. With a population exceeding 2.5 million inhabitants (World Population Review, 2024), Tangerang's growth trajectory underscores its significance as a vital contributor to Indonesia's economy and urban landscape.

Tangerang's smart city initiatives epitomize its commitment to leveraging technology and innovation to address urban challenges and enhance the quality of life for its residents.

The Tangerang Integrated Smart Traffic Management System (TISTMS) is a flagship project to revolutionize urban mobility and transportation efficiency. TISTMS optimizes traffic flow, minimizes congestion, and reduces travel times on key road networks by harnessing advanced technologies, including AI, IoT, and big data analytics. Real-time monitoring and adaptive signal control algorithms enable dynamic traffic management, mitigating gridlock and improving overall traffic efficiency. As a result, commuters experience smoother journeys, businesses benefit from enhanced logistics operations, and the city reduces its carbon footprint and economic losses associated with traffic congestion.

In tandem with traffic management, Tangerang has prioritized public safety and security through comprehensive smart city initiatives. Deploying CCTV cameras across strategic locations enhances monitoring and surveillance capabilities, deterring criminal activities and enhancing law enforcement effectiveness. Mobile surveillance units equipped with cutting-edge technologies enable rapid response to incidents, augmenting situational awareness and ensuring timely interventions. Additionally, community policing programs foster collaboration between law enforcement agencies and local communities, promoting a culture of shared responsibility and proactive crime prevention.

Tangerang's smart city initiatives underscore its proactive approach to urban management and development, emphasizing the integration of technology, data-driven solutions, and community engagement. Tangerang aims to create a safer, more efficient, and sustainable urban environment by leveraging smart technologies to optimize transportation systems, enhance public safety, and empower residents. Moreover, these initiatives position Tangerang as a model for smart city innovation in Indonesia, demonstrating the transformative potential of technology in addressing complex urban challenges and improving the quality of life for its citizens.

Community Perceptions on Technology and Smart City Initiatives

Some participants expressed enthusiasm and optimism about the transformative potential of technology in enhancing urban living conditions. They perceived smart city initiatives as promising innovation, efficiency, and improvement avenues. Younger respondents, in particular, exhibited greater acceptance and enthusiasm towards technological

advancements, viewing them as catalysts for progress and development. They embraced the prospect of smarter infrastructure, enhanced connectivity, and improved service delivery facilitated by technology-driven solutions.

Conversely, a segment of respondents harbored concerns and skepticism regarding the proliferation of technology and its implications for society. Privacy, data security, and the digital divide emerged as prominent areas of apprehension among certain participants. Older generations, in particular, expressed reservations about the rapid pace of technological change and its potential societal ramifications. They raised questions about data privacy, surveillance, and the equitable distribution of technological benefits across demographic groups.

The analysis revealed a notable divergence of opinions regarding the perceived impact of technology on social interactions and community cohesion. While some residents embraced the convenience and efficiency of smart city technologies, others voiced apprehensions about the potential erosion of human connection and traditional community values. The advent of digital communication platforms and automation raised questions about preserving face-to-face interactions, social bonds, and cultural heritage within communities.

The varied responses reflect the complex interplay between technological innovation, societal values, and urban development aspirations. While technology promises to address urban challenges and improve quality of life, it also raises legitimate concerns about privacy, equity, and social cohesion. Acknowledging and addressing these concerns is essential for fostering inclusive, people-centric smart city initiatives that empower communities, preserve cultural identities, and uphold fundamental rights and values in the digital age. Moreover, fostering dialogue, promoting digital literacy, and ensuring transparent governance are crucial steps towards building trust and bridging the gap between technological aspirations and societal expectations within smart cities.

Effectiveness of Current Community Education Programs

The study uncovered a spectrum of awareness and engagement levels among residents concerning community education programs associated with smart city initiatives. While some individuals actively participate in educational workshops, seminars, and digital literacy programs, others remain unaware of such opportunities. This discrepancy underscores the importance of implementing more robust outreach strategies to ensure that all population segments are informed about the available programs and opportunities for involvement.

Moreover, accessibility emerges as a significant challenge impacting the effectiveness of these educational endeavors. Some residents may encounter barriers such as limited internet access, transportation constraints, or competing priorities that hinder their full participation. Addressing these accessibility challenges necessitates innovative approaches, including providing online resources, mobile learning options, and flexible scheduling to accommodate diverse needs and circumstances.

Furthermore, concerns were raised regarding the relevance and inclusivity of existing education programs. Participants expressed doubts about the programs' ability to address the specific needs and interests of different demographic groups within the community. Recognizing the diversity in backgrounds, languages, and learning styles among residents is paramount for designing inclusive educational experiences that resonate with all participants and foster meaningful engagement.

To enhance the effectiveness of community education programs, stakeholders must prioritize continuous improvement and innovation. This involves soliciting participant feedback to identify areas for enhancement, incorporating best practices in adult education and community engagement, and forging partnerships with local organizations and educational institutions to expand resources and reach. Additionally, promoting active community participation through interactive workshops, hands-on activities, and collaborative projects can cultivate a sense of ownership and empowerment among residents, driving greater impact and sustainability in smart city initiatives.

Identifying Barriers to Community Engagement in Smart City Initiatives

Several barriers to community engagement in smart city initiatives were identified through the analysis. Key obstacles included:

- a) **Digital Divide:** The existence of a digital divide underscores the urgent need for targeted interventions to bridge the gap in access to technology and digital literacy skills. Addressing this barrier requires equitable distribution of resources, investments in digital infrastructure, and comprehensive digital literacy programs tailored to the needs of underserved communities. By ensuring universal access to technology and empowering residents with digital skills, cities can promote social inclusion, economic opportunity, and civic engagement, laying the foundation for more equitable and inclusive smart city development.

- b) **Lack of Awareness:** Overcoming the barrier of limited awareness necessitates proactive communication strategies and community outreach efforts to inform residents about available resources, opportunities, and the benefits of smart city initiatives. By raising awareness and fostering a culture of transparency and openness, cities can empower residents to make informed decisions, participate actively in urban development processes, and contribute to the co-creation of smart and sustainable cities.
- c) **Skepticism and Mistrust:** Addressing skepticism and mistrust towards smart city initiatives requires building trust through transparent communication, stakeholder engagement, and participatory decision-making processes. Cities must prioritize privacy protection, data security, and ethical considerations in designing and implementing smart city projects, ensuring that residents' rights and interests are safeguarded. By fostering trust and confidence in smart city governance, cities can foster collaboration, social cohesion, and collective action toward shared urban goals.
- d) **Cultural and Linguistic Barriers:** Overcoming cultural and linguistic barriers demands culturally sensitive and linguistically appropriate approaches to community engagement, ensuring that all residents, regardless of background, feel included and represented in smart city initiatives. Cities must invest in language interpretation services, culturally relevant communication materials, and diverse engagement platforms to bridge communication gaps and foster a sense of belonging and ownership among diverse communities. By embracing diversity and promoting inclusive participation, cities can harness their residents' collective wisdom and creativity to drive innovation and positive change.
- e) **Limited Civic Participation:** Addressing the barrier of limited civic participation requires creating inclusive platforms for citizen engagement, empowering residents to participate in decision-making processes and co-create solutions to urban challenges. Cities must adopt participatory governance models, such as citizen assemblies, participatory budgeting, and civic forums, to amplify residents' voices, build social capital, and strengthen democratic governance. By fostering a culture of civic engagement and collaboration, cities can tap into their communities' collective intelligence and creativity to build more resilient, livable, and sustainable cities for all.

Discussion

The findings of this study carry significant implications for the development and implementation of smart city initiatives in Indonesia as per the 'Towards 100 Smart Cities' initiative. The mixed perceptions towards technology and smart city initiatives underscore the importance of addressing privacy, data security, and the digital divide concerns. Initiatives to build trust, foster transparency, and promote digital literacy are essential to ensuring widespread acceptance and participation among urban residents.

The effectiveness of current community education programs highlights the need for targeted interventions to enhance accessibility, relevance, and inclusivity. Strengthening educational outreach efforts, tailoring content to diverse audiences, and leveraging community partnerships can help bridge knowledge gaps and empower residents to engage actively in smart city development.

Furthermore, identifying barriers to community engagement, such as the digital divide and limited civic participation, underscores the importance of adopting inclusive and participatory approaches in smart city planning and governance. Addressing these barriers requires collaborative efforts between government agencies, community organizations, and private stakeholders to ensure that smart city initiatives benefit all segments of society.

The findings of this study align with and extend existing literature on smart city development and community engagement. Previous research has highlighted the importance of addressing privacy, security, and inclusivity concerns in smart city initiatives (Appio et al., 2019; Hollands, 2008). Similarly, studies have emphasized the role of community education in fostering citizen participation and empowerment (Nam & Pardo, 2011; Offenhuber, 2019).

However, this study provides a more nuanced understanding of these issues within the Indonesian context. While some respondents expressed optimism about the potential benefits of technology, others harbored concerns about privacy, data security, and the digital divide (Appio et al., 2019; Hollands, 2008). This mirrors global trends but also underscores the unique challenges faced by Indonesia, such as cultural and linguistic diversity.

Furthermore, the study highlights the effectiveness of current community education programs in raising awareness about smart city concepts (Nam & Pardo, 2011; Offenhuber, 2019). However, it also identifies gaps in accessibility and inclusivity, indicating a need for targeted interventions to reach marginalized communities. Focusing on urban residents' perceptions and experiences, the study offers valuable insights into the unique challenges and opportunities facing smart city development in Indonesia. Identifying cultural, linguistic, and socio-economic barriers adds depth to our

understanding of the complexities of implementing smart city initiatives in diverse and rapidly evolving urban environments.

Despite its contributions, this study has several limitations that warrant consideration. Firstly, the cross-sectional design limits the ability to establish causal relationships between variables. Longitudinal studies are needed to examine the long-term impacts of community education programs and smart city initiatives on urban development outcomes.

Secondly, the reliance on self-reported data may introduce response bias and social desirability effects. Future research could incorporate objective measures, such as observational data or objective assessments of digital literacy skills, to enhance the validity and reliability of findings.

Additionally, the study's sample may not fully represent the Indonesian urban population, particularly in regions with limited internet access or lower levels of digital literacy. Efforts to reach marginalized communities and ensure their inclusion in future research are essential to address potential biases and gaps in understanding.

Building on the findings of this study, future research could explore several avenues for further investigation. Firstly, longitudinal studies could examine the long-term impacts of community education programs on urban development outcomes, such as social cohesion, economic growth, and environmental sustainability.

Secondly, comparative studies across different regions and cities could provide insights into variations in community perceptions and engagement with smart city initiatives. Researchers can identify best practices and lessons learned for smart city development in diverse settings by examining contextual factors and local dynamics.

Furthermore, qualitative research methods, such as focus groups and participatory action research, could deepen our understanding of community perspectives and experiences. Engaging residents as active participants in the research process can foster collaboration, co-creation, and ownership of smart city initiatives.

More than that, interdisciplinary approaches that integrate insights from urban planning, sociology, and technology studies are needed to address the complex challenges of smart city development. By bringing diverse perspectives and expertise together, researchers can develop holistic and inclusive strategies for building smarter, more sustainable cities in Indonesia and beyond.

This study contributes to the growing body of literature on smart city development and community engagement by providing insights into the perceptions, attitudes, and barriers facing urban residents in Indonesia. By addressing technology, education, and participation concerns, policymakers, planners, and stakeholders can work towards building more inclusive, resilient, and sustainable cities for all.

CONCLUSION

The findings reveal a nuanced understanding of urban residents' perspectives, highlighting a mixture of optimism and concerns regarding technology and smart city initiatives. While some embrace the potential benefits of technology, others express apprehensions about privacy, data security, and the digital divide. These insights underscore the unique challenges faced by Indonesia, emphasizing the need for culturally sensitive and inclusive approaches to smart city planning and governance.

The study also highlights the effectiveness of current community education programs in raising awareness about smart city concepts. However, gaps in accessibility and inclusivity suggest the need for targeted interventions to reach marginalized communities. Moreover, identifying barriers to community engagement emphasizes the importance of inclusive and participatory approaches in smart city planning and governance.

Community education is crucial in promoting smart city development and fostering citizen participation and empowerment. By enhancing digital literacy, raising awareness, and promoting inclusive dialogue, community education programs can bridge knowledge gaps and empower residents to actively engage in shaping their urban environments. Policymakers and urban planners must prioritize investments in community education initiatives to ensure that smart city development is inclusive, equitable, and responsive to the needs of all residents.

In light of the findings, several recommendations are proposed for policymakers and urban planners. Firstly, enhancing collaboration between government agencies, community organizations, and private stakeholders is crucial to developing holistic and inclusive smart city development strategies. Secondly, efforts should be made to address the digital divide and promote digital inclusion through targeted educational interventions and infrastructure investments. Additionally, policymakers should prioritize transparency, accountability, and community engagement in designing and implementing smart city initiatives to build trust and foster stakeholder collaboration.

For future research, it is recommended to delve deeper into specific demographic groups' perceptions and needs regarding smart city development. Longitudinal studies can provide insights into the long-term impacts of community education programs on residents' attitudes and behaviors. Comparative studies across different cities or regions can also offer valuable insights into the effectiveness of various smart city strategies and interventions. Additionally, qualitative research exploring the experiences of marginalized communities in smart city initiatives can inform more inclusive and equitable approaches to urban development. Overall, continued research in this field is essential for advancing our understanding of smart city development and ensuring that future initiatives are responsive to the diverse needs of urban residents.

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