e-Bangi Faculty of Social Sciences and Humanities Universiti Kebangsaan Malaysia
Journal of Social Sciences and Humanities

eISSN: 1823-884x

Volume 22, Issue 4, DOI: https://doi.org/10.17576/ebangi.2025.2204.62

Article

Youth Awareness and Participation in Smart City Development in Malaysia

Muhammad Izzuddin Mohd Yazri[1], Nor Azrul Mohd Zin[1*] & Syazwani Yahaya[2]

[1]Center for Research in Development, Social and Environment, Faculty of Social Science and Humanities, Universiti Kebangsaan Malaysia, 43600 Bangi, Selangor, Malaysia
[2]School of Management and Business, MILA University, 71800 Nilai, Negeri Sembilan

*Corresponding Author: norazrul.zin@ukm.edu.my

Received: 13 August 2025
Accepted: 15 November 2025

Abstract: This study investigates the awareness of Malaysian urban youth concerning intelligent city concepts and their potential as human capital in advancing smart city development. In the context of accelerated global urbanization and the rising demographic significance of young populations, youth engagement is becoming an essential component of sustainable urban transformation. However, empirical evidence on youth awareness and participation in smart city initiatives in Malaysia is still limited. To address this gap, a survey of 200 youths aged 15 to 30 in Putrajaya and Iskandar was conducted using purposive and convenience sampling. Respondents completed structured items adapted from established smart city frameworks, covering the six smart city dimensions and youths' perceived roles in urban innovation, measured on a 5-point Likert scale.The findings reveal a substantial level of awareness among respondents, with strong recognition of key smart city elements such as digital infrastructure, sustainable environments and intelligent mobility systems. The majority also expressed positive perceptions of their responsibility and capability to contribute, with 81.5 percent strongly agreeing that youth should monitor smart city services and promote digital awareness. The results demonstrate that urban Malaysian youth constitute an underutilised human capital resource that can significantly support intelligent urban development. By integrating technological and human capital perspectives, this study enriches smart city literature with a people-centered analytical orientation. Policy implications suggest that national frameworks such as the Malaysian Smart Cities Framework should prioritise youth empowerment through education, digital skills enhancement and participatory planning to strengthen inclusive and future-oriented urban communities.

Keywords: Smart Cities; urban youth; human capital development; digital awareness; youth participation

Introduction

Cities worldwide are undergoing rapid digital transformation to become "smart cities," leveraging technology and data to improve urban life (De Bem Machado et al., 2023; Karthikeyan, 2024). A widely cited definition conceptualizes a smart city as a city well performing in a forward-looking way in six characteristics (economy, people, governance, mobility, environment, living), built on the smart combination of endowments and activities of self-decisive, independent, and aware citizens (Ulfik, 2024; Tsipouri & Liarti, 2022; Ozkaya & Erdin, 2020; Turgel et al., 2019; Simonofski et al., 2019). This holistic view, first advanced by Giffinger et al. (2007), emphasizes that smart cities encompass not only ICT infrastructure but also people and human capital (Belli et al., 2020; Chang et al., 2020; Streimikis et al., 2021). Indeed, standards bodies such as Malaysia

Standard (MS) ISO 37122:2019 emphasize the integration of physical, digital, and human systems to achieve inclusive and sustainable urban futures (Department of Standard Malaysia, 2021).

Globally, youth constitute an increasingly large share of urban populations, especially in developing regions (Sakil, 2017). By 2030, over 60% of urban dwellers will be under the age of 18 (Bose et al., 2021) . Young people bring vibrancy, innovation, tech savvy, and connectedness to cities (Demir, 2022). They are frequently early adopters of technology and drivers of social change (Masucci et al., 2019). Recognizing this, international frameworks have called for greater youth inclusion in sustainable urban development and smart city initiatives (Sowmiya & Velavan, 2025). However, youth are still too often seen merely as "future citizens" waiting in the wings of urban planning, rather than as active stakeholders in the present (McKoy et al., 2021; Zeadat, 2023). Recent studies in Europe have shown that teenagers possess distinct perceptions and values regarding smart cities and desire to have their voices heard in shaping future city visions (Picatoste et al., 2019; Castilla & Müller, 2023). However, formal mechanisms for youth participation remain limited (Shtebunaev et al., 2023).

In Malaysia, the smart city agenda has accelerated in the past decade (Abdul Malek et.al., 2017; Dali et al., 2022; Samsudin et al., 2022). Flagship initiatives such as the Multimedia Super Corridor (since 1996), Cyberjaya and Putrajaya developments, and the Malaysia Smart City Framework (MSCF 2019) illustrates the nation's commitment to technologically advanced, sustainable cities. These efforts align with the global Sustainable Development Goals and the ASEAN Smart Cities Network objectives (Michael & Salleh, 2023). Notably, Malaysia's Twelfth Malaysia Plan (2021–2025) explicitly frames youth as catalysts for digital economy growth and innovation-driven development. The Ministry of Youth and Sports (KBS) has also launched the Youth Development Model 2030, which aims to holistically empower youth (including digital skills, civic participation, and leadership) as a strategic human capital for the nation (Ministry of Youth and Sports, 2023). Despite supportive policies, there is a lack of empirical research on Malaysian youth's awareness of smart city concepts and the extent of their involvement or readiness to participate in smart city development. How well do young Malaysians understand the imaginative city vision, and do they see themselves as active contributors to it? These questions are important, as youths' attitudes and knowledge will influence the success of smart city projects aimed at improving citizens' quality of life.

Literature Review

1. Smart City Concepts and Framework

The term *"smart city"* encompasses a range of definitions and frameworks in academic and policy discourse (Srivastava & Sharifi, 2022; Chourabi et al., 2012). Early formulations emphasized technological innovation, where cities leverage ICT (information and communication technology) (Tahir, 2016; Tcholtchev & Schieferdecker, 2021), sensor networks, and data analytics (Ali, 2020) to optimize urban systems including transport, energy and governance (S et al., 2024). Scholar also described the smart city as an urban future where integrated ICT infrastructure makes cities safer, greener, and more efficient (Loss et al., 2024; Hermanus et al., 2024; Nusrat et al., 2023; Putra et al., 2025). However, more holistic definitions soon emerged, integrating human and social factors alongside technology. Giffinger et al. (2007) provided one of the most influential conceptualizations by outlining six key dimensions of a smart city:

i. Smart Economy: competitiveness, innovation, entrepreneurship, and productivity in the city's economic base;
ii. Smart People: a society with a high level of human capital, education, creativity, and inclusivity;
iii. Smart Governance: participatory governance, transparency, and efficient public services using technology;
iv. Smart Mobility: sustainable and integrated transport systems, ICT-enabled logistics, and accessibility;
v. Smart Environment: sustainable management of resources and environment (energy, waste, green spaces) via technology;

vi. Smart Living: quality of life improvements in housing, safety, health, cultural and educational amenities through smart solutions.

This framework views a city as *"well-performing in a forward-looking way"* across these dimensions through a synergistic combination of technological infrastructure, institutional smart policies, and the proactive engagement of *"independent and aware citizens"*. Importantly, citizens' awareness and participation were inherent to this definition a point sometimes overlooked when cities focus narrowly on tech deployment.

The Giffinger model has guided numerous smart city rankings and initiatives such as European Smart Cities Ranking. However, it has also faced criticism. Scholars argue that while the model identified what a smart city *should achieve*, it did not explicitly detail *how citizens are involved* in reaching those goals. Neirotti et al. (2014) and Meijer & Bolívar (2016) noted that early smart city frameworks tended to be top-down, lacking mechanisms for citizen input and co-creation. In response, contemporary approaches have sought to infuse a stronger citizen-centric orientation.

One such approach is the Citizen-Centric Smart City (CCSC) model proposed by Lim and Jalaluddin (2022). This model re-centres the smart city concept around citizens' active roles and responsibilities. Lim and Jalaluddin argue that instead of viewing citizens merely as *customers* or end-users of smart services, cities should treat citizens as partners in creating solutions. The CCSC model, grounded in the idea of

Participatory governance suggests that citizens including youth should co-produce, participate in, and contribute to building the smart city alongside governments and businesses (Castelnovo & Romanelli, 2020). This includes involving citizens in decision-making, designing urban innovations, and community initiatives. The model reflects a broader trend in urban planning that echoes Arnstein's Ladder of Participation (1969) which aiming to elevate citizens from token consultation to true collaboration or empowerment in city development. By focusing on citizens' responsibilities and agency, the CCSC model also aligns with concepts of "smart citizenship" and the "right to the city" in the digital age. For youth in particular, this model suggests that young people should no longer be viewed as passive "recipients" of smart city policies, but rather as active co-creators of urban solutions. Indeed, Lim and Jalaluddin (2022) on people-centric perspective suggests the success of a smart city hinges on forming a digitally literate, inclusive, and engaged community, rather than just implementing cutting-edge technology.

Alongside these conceptual shifts, international organizations have highlighted the human and social dimensions of smart cities. The OECD (2020) has put forth a Framework for Digital Talent and Skills as part of its digital government strategies, underscoring that human capital development must keep pace with technological advancements. This framework expanded classical human capital theory by recognizing that in the digital era, a skilled population requires more than formal education – it demands continuous upskilling, cross-disciplinary problem-solving abilities, adaptability, and a collaborative mindset. The OECD emphasizes that digital skills should be viewed as dynamic, requiring lifelong learning and regular updates, particularly as cities adopt new technologies. It also introduces the idea of "digital talent maturity" at an organizational level: smart cities and public agencies should create an ecosystem that supports ongoing learning and innovation among their workforce and citizens. In essence, the OECD perspective aligns with the notion that smart cities need smart people individuals who are not only tech-literate but also agile, civic-minded, and capable of leveraging technology for the public good.

2. Youth as Strategic Human Capital in Smart Cities

Youth

The classification of *youth* varies across contexts. Malaysia's Youth Societies and Youth Development (Act 668), amended in 2019, defines youth as persons between 15 and 30 years old, aligning with our study's target group (The Commissioner of Law Revision, Malaysia, 2014; Ministry of Youth and Sports, 2023). Youth is a critical life stage where education, skills, values, and civic identities are being formed. In the context of a knowledge-driven and digital economy, youth are often hailed as a country's key human capital assets the innovators, entrepreneurs, and leaders of tomorrow. Becker's (1964) human capital theory traditionally

posited that investments in education and training enhance individuals' productivity and economic growth. Applying this to youth suggests that a nation's development hinges on equipping young people with the knowledge and skills they need to succeed.

2. Human Capital in the Digital Era

Classic human capital theory is being reimagined in light of 21st-century demands. As noted, the OECD (2020) modern perspective, advocates for a more comprehensive view of human capital development, particularly in the context of the digital economy. For youth, this means that formal education alone is insufficient; digital literacy (Leybert et al., 2022), critical thinking (T et al., 2024), creativity (Simchenko et al., 2023), and social-emotional skills (Choi, 2024) are equally important. The OECD highlights competencies such as collaborative problem-solving and adaptive learning as essential in a rapidly changing technological landscape. Moreover, it emphasizes that skills must be continuously updated, a principle particularly relevant to young people who will face multiple waves of technological change throughout their careers. In smart city contexts, youth who are adept at new technologies such as AI, IoT, and data analytics and can work across various sectors including tech, government, and community are viewed as strategic assets (Barba-Sánchez et al., 2021). They are the ones who will operate smart city systems and perhaps devise new urban innovations.

Malaysia's policy discourse increasingly reflects this thinking. The Economic Planning Unit's policy documents RMK-12 identify youth as active drivers of the country's digital and innovation agenda (Economic Planning Unit, 2021). The idea of "homo intelligence" is promoted, recognizing young people as catalysts for socio-economic advancement and as agents of change in communities. Jalaluddin (2009) introduced the notion of "homo intelligence" portraying modern youth as not just tech-savvy consumers but as creative digital innovators who can contribute to societal well-being. This concept aligns with viewing youth as a distinct resource class in smart cities a generation comfortable with technology who can help cities not only adopt innovations but also address social challenges through fresh ideas.

3. Youth Engagement in Smart Cities (Global and Local)

Globally, there is a growing interest in involving young people in urban planning and smart city projects. The UN-Habitat Youth Unit and initiatives like underscore that engaging youth can yield multiple benefits (United Nations Human Settlements Programme et al., 2022), it also can help to enhance civic skills, ensure that city services meet the needs of young citizens, and tap into youths' creativity for urban solutions (Blanchet-Cohen & Torres, 2024). YouthfulCities' assessments reveal that while young people bring "vibrancy, innovation, tech-savviness, and connectedness" to urban life, many cities struggle to retain youth or involve them in governance. For instance, cities like Toronto rank highly in overall youthful resources but low in youth civic engagement, such as voting and volunteering. The implication is that cities could benefit from more deliberate strategies to integrate youth voices and leadership in city development. Some approaches observed globally include youth councils advising city hall, youth hackathons for urban challenges, "smart internships" where students contribute to city data projects, and gamified consultations.

In the Malaysian context, youth engagement in urban governance is still in its early stages of development. Traditionally, local governance had limited formal roles for youth (Krauss et al., 2020). However, with the advent of smart city programs in places like Kuala Lumpur, Selangor, Iskandar, and Penang, new opportunities have emerged for youth-led tech initiatives and community projects. For example, hackathons and innovation competitions targeting young developers have been sponsored to create civic solutions such as transit apps, public safety reporting tools. The Malaysia Smart City Framework (MSCF) explicitly lists "Smart People" as one pillar, envisioning human capital development and social participation. Still, detailed guidance on youth inclusion is minimal. Lim and Jalaluddin (2022) note that both the British Smart City Standards and the MSCF recognize citizens' roles in theory. However, the practical integration of citizen and youth participation remains "superficial and unclear" without concrete mechanisms in place (Kougias & Papadakaki, 2025; Gohari et al., 2020). They advocate for a more robust incorporation of citizenship rights and responsibilities into smart city standards, to avoid tokenistic "citizen-first" rhetoric.

Empirical research on youth and smart cities is in its early stages. One relevant study by Shtebunaev et al. (2023) involved 121 teenagers from four cities which are Manchester, Birmingham, Valencia, Sofia discussing smart city concepts. It found that youths are often aware of the digital technologies affecting their city life and have strong opinions on issues such as digital equity, the environment, and public spaces. Many expressed a desire for inclusive, "people-centered" smart city visions rather than purely technology-centric ones. The study cautioned that, despite being digital natives, not all young people automatically understand or embrace the smart city agenda – awareness and understanding can vary, and a "digital divide" even exists within youth populations in terms of skills and access. This suggests that measuring youth awareness of specific smart city elements is important: youths might be using smart city services daily without labeling them as part of a "smart city." Indeed, Przeybilovicz & Cunha (2024) noted that many young people interact with smart city components (such as free Wi-Fi and app-based transit information) but are not familiar with formal policy terminology. Therefore, assessing practical awareness provides insight into the real extent of youth engagement.

Methodology

This study employed a quantitative cross-sectional survey design to assess Malaysian urban youths' awareness and perceptions of smart city development, focusing on Putrajaya and Iskandar Malaysia, which were selected because they represent national smart city frontrunners with advanced digital governance, visible smart infrastructure, and high concentrations of youth. Using a purposive and convenience sampling approach, a total of 200 respondents aged 15 to 30 who lived, studied or worked in these areas participated voluntarily through paper-based and online questionnaires. The instrument consisted of three parts which were demographic information, awareness items aligned with the six Giffinger smart city dimensions, and youth human capital roles, all measured using a 5-point Likert scale and pre-tested for clarity. Data were screened for eligibility and analysed using descriptive statistics in SPSS to produce frequencies, means and standard deviations suitable for exploratory assessment.

Several methodological limitations are acknowledged, including sampling bias due to the dominance of educated urban youth, limited geographic coverage, reliance on self-reported responses, and the non-probability sampling technique that restricts generalizability, although the approach still provides meaningful preliminary insights into youth engagement within Malaysia's evolving smart city landscape.

The Findings & Discussion

1. Respondent Demographics

This study highlight key demographic characteristics of the respondents (N = 200). The sample consisted of 48% males and 52% females. The age distribution was skewed towards the mid-to-upper end of the youth range: two-thirds were aged 25–30, approximately 28% were 20–24, and only 6% were in their late teens (15–19). This suggests that our respondents primarily represent young adults, many of whom are in early career stages or pursuing higher education. Education levels were relatively high, with 55% holding a bachelor's degree (or currently undergraduates), and roughly 27% having postgraduate or diploma qualifications, leaving under 20% with only secondary schooling. In terms of occupation, a plurality were public-sector employees (36%), reflecting the concentration of government jobs in Putrajaya; the rest were split between the private sector, including Iskandar's economic zones, and students/unemployed. Notably, only around 28% of respondents reported any involvement in local community or resident organizations, whereas 72% said they were *"not active"* in such groups. This suggests that a majority had no formal civic engagement experience at the community level, a point to consider when interpreting their views on participation. Nonetheless, as digital natives, many may engage in informal networks or online communities, even if they are not part of traditional organizations.

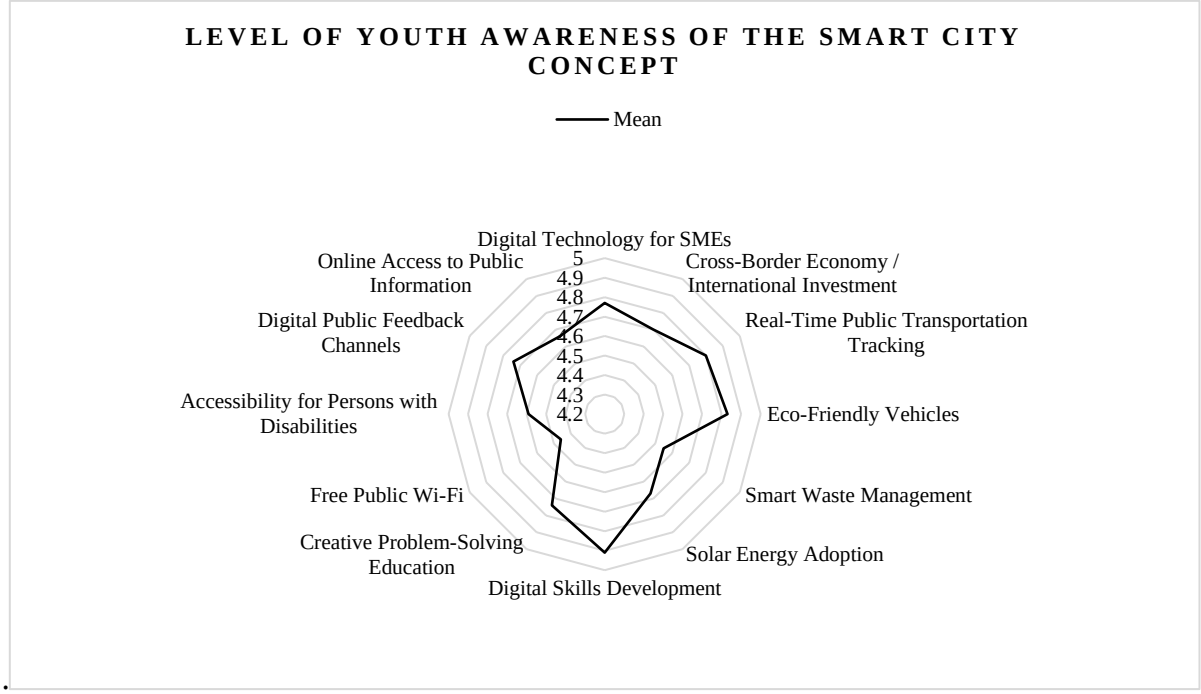

Figure 1. Mean level of youth awareness across 12 smart city dimensions in Malaysian urban contexts

2. Youth Awareness: Digital Natives Living in Smart Cities

The finding of consistently high awareness across multiple smart city domains suggests that urban Malaysian youth are not only technologically adept in a general sense but are also attuned to specific smart infrastructure and policy initiatives in their environments. This supports the view that today's youth, described by scholar as already adept at living in a hyper-connected world, are effectively embedded within the smart city paradigm by default (Shtebunaev et al., 2023b). For instance, a large majority of respondents reported awareness of real-time transit tracking systems as a top-tier item. It showed moderate yet notable awareness of solar energy adoption, reflecting the visibility of these technologies in everyday urban life.

These results mirror global patterns. Shtebunaev et al. (2023), for example, found that teenagers in various urban contexts demonstrated strong experiential awareness of smart city features such as digital mobility tools and tech-enhanced public spaces. Our methodology, which measured awareness through concrete and relatable examples rather than abstract terminology, proved particularly effective. This aligns with the argument by Przeybilovicz and Cunha (2024), who note that youth often engage with smart city components such as public Wi-Fi and e-government services without necessarily using or understanding the label "smart city." In the Malaysian context, our data affirm that youth engagement with smart city elements is high in practice, offering encouraging evidence for policymakers. It suggests that initiatives implemented in cities like Putrajaya and Iskandar are not only operational but also visible and resonant with the younger population, either due to intentional outreach or organic exposure through daily use.

A nuanced finding concerns the relatively lower levels of awareness around "smart living" elements, particularly public Wi-Fi and facilities for persons with disabilities (OKU). Several interpretations are plausible. For one, these amenities may not yet be ubiquitous, such as public Wi-Fi access for example, it may be limited to select zones, and youth, who tend to rely on mobile data, may not seek out or notice such services. Similarly, accessibility improvements may be less salient to able-bodied youth unless they have direct contact with individuals who require such accommodations. Existing literature suggests that the social inclusion aspects of smart cities often lag behind more visible technological deployments. Our findings appear to support this pattern while infrastructural and environmental technologies such as mobility, energy, sustainability are widely recognized by youth, inclusive services are less prominently registered. This highlights an area for policy enhancement, local governments could expand and better communicate inclusive "smart living"

programs, potentially leveraging youth as advocates and amplifiers to enhance visibility and engagement (C. Wang et al., 2021; Makkonen & Inkinen, 2024).

Finally, the Smart People dimension, particularly initiatives aimed at human capital development, emerged as the most recognized, with 92.5% of respondents expressing strong awareness of digital skills programs. This reflects Malaysia's robust national agenda to foster digital literacy and future-ready education within frameworks such as IR4.0 and the digital economy strategy. The high youth recognition of such efforts suggests not only widespread exposure to digital rhetoric but also the internalization of the imperative to upskill continuously. This finding contrasts with critiques in earlier smart city literature, such as Hollands (2008), which argue that many smart city initiatives have been overly technocratic, often excluding or alienating citizens. Therefore, in the Malaysian context, such critiques may be less applicable to youth. Rather than being sidelined, urban youth appear to be highly engaged, with a strong awareness of both policy initiatives and tangible smart city features that are embedded in their daily lives.

2. Youth as Human Capital

The strong consensus among respondents regarding their prospective roles within smart cities underscores a significant alignment between policy discourse and youth self-perception. The conceptualization of youth as strategic human capital, a recurrent theme in national and international urban development agendas, is internalized by the youth themselves. Rather than perceiving themselves as passive recipients of innovation, these individuals articulate a proactive identity, envisioning their generation as capable of monitoring, educating, innovating, and leading within the smart city ecosystem (Maltseva et al., 2021). This self-ascribed agency lends empirical support to the CCSC model (Lim & Jalaluddin, 2022) which advocates for the inclusion of youth as co-creators in the development of smart cities. Our findings suggest that youth are not only receptive to this model but actively embody its principles, essentially asserting, "We are ready to co-create, and here is how."

These perceptions also resonate with the OECD's framework of active digital citizenship, in which young people are not only expected to adapt to rapid digital transformation but to assist others in doing so, particularly in closing the digital divide. Respondents' support for mentoring roles and inclusive digital practices illustrates this dual commitment to personal adaptation and communal contribution. In effect, the study's youth affirm what theorists and policy advocates have long maintained: that sustainable, future-ready cities must mobilize the energy, digital fluency, and creativity of young citizens.

One of the most notable findings is the specificity with which youth delineated their prospective contributions. Many expressed a willingness to engage in governance activities, such as monitoring service delivery or participating in consultative committees, suggesting a shift toward more participatory governance. This aligns with the IAP2 Spectrum of Public Participation, specifically the "involve" and "collaborate" tiers, where youth transition from being informed to actively shaping outcomes. Additionally, youth interest in contributing data and knowledge aligns with emerging paradigms in citizen sensing and crowdsourced urban data (Bennett & Hays, 2022). These aspirations present clear opportunities for local authorities: digital platforms that facilitate youth reporting of infrastructure faults or environmental concerns or collaborative mapping efforts could be met with strong engagement, especially given that 97% of respondents endorsed this role.

Moreover, youth showed considerable openness to intergenerational digital mentorship, a function often underemphasized in smart city strategies. Initiatives that formally recruit youth as digital navigators or peer educators, especially for older residents, could enhance community resilience and foster intergenerational solidarity (Rauhaus & Guajardo, 2021; Gruben et al., 2025). Such roles highlight the multifaceted nature of youth contributions, extending beyond technology use to include community building and social inclusion.

Conversely, the least endorsed role, being lifestyle pioneers, warrants critical reflection. Approximately 18% of respondents did not actively agree with this role, raising questions about the underlying reasons for their disagreement. One interpretation is that youth already consider themselves integrated with digital tools in everyday life, rendering the proposition unremarkable rather than aspirational (Symeonaki et al., 2025). Alternatively, this ambivalence may reflect deeper concerns about technological overreach, privacy, or

economic constraints. Not all youth have access to advanced smart devices or can afford emerging technologies such as electric vehicles or home automation systems (Rahman et al., 2025). As such, reluctance to endorse the "pioneer" label may reflect structural limitations rather than ideological resistance.

Conclusion

This study presents an empirical analysis of Malaysian youths' awareness of and engagement with smart city initiatives, with a focus on Putrajaya and Iskandar Malaysia. The findings are encouraging: urban youth demonstrate a strong awareness of smart city components and express a clear desire to be proactive participants in shaping their urban futures. These results affirm youth as a critical driver of human capital in smart urban transformation, aligning with frameworks that emphasize the integration of civic participation and technological innovation.

Theoretically, this research supports the view that youth are essential actors in achieving smart city goals. While often presumed to be digitally engaged, youth perspectives remain underrepresented in the literature. This study helps fill that gap by identifying specific areas of youth interest such as data sharing, civic innovation, and digital mentorship, thus advancing the conceptualization of "smart people" from abstraction to action.

For policymakers, the implications are clear which youth represent a high-potential yet underutilized resource in smart city development. Institutional mechanisms to support youth participation and innovation ecosystems are vital for shifting from top-down planning to inclusive, citizen-driven governance. As the maxim goes, "nothing about us without us" youth inclusion enhances legitimacy, innovation, and long-term success.

However, challenges persist. Youth enthusiasm must be met with genuine opportunities, and inclusion must extend beyond educated urban youth to marginalized and rural populations. Sustained engagement will require ongoing mentorship, recognition, and diverse entry points for participation.

This research aligns with several UN SDGs, notably Goal 11 (Sustainable Cities), Goal 4 (Quality Education), Goal 8 (Decent Work), Goal 16 (Inclusive Institutions), and Goal 17 (Partnerships). It emphasizes youth as co-creators in urban governance, highlighting their role in fostering equitable, inclusive, and resilient urban environments.

Future research should investigate longitudinal patterns of youth engagement, the motivations behind participation, and cross-regional comparisons to assess the contextual influences. Ultimately, while smart cities are often defined by technology, this study affirms they must first be about people particularly the digitally fluent and socially engaged youth poised to lead the way.

Acknowledgement: All respondent who participated in the study for making data collection possible.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

References

Ali, M. (2020). Big data and machine intelligence in software platforms for smart cities. In *Communications in computer and information science* (pp. 17–26). https://doi.org/10.1007/978-3-030-59155-7_2

Arnstein, S. R. (1969). A ladder of citizen participation. *Journal of the American Institute of Planners*, *35*(4), 216–224. https://doi.org/10.1080/01944366908977225

Barba-Sánchez, V., Orozco-Barbosa, L., & Arias-Antúnez, E. (2021). On the Impact of Information Technologies Secondary-School Capacity in Business Development: Evidence From Smart Cities Around the World. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.731443

Becker, G. S. 1964. *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.* Chicago: University of Chicago Press.

Bennett, K. M., & Hays, S. P. (2022). Engaging youth for positive change: A quantitative analysis of participant outcomes. *Education Citizenship and Social Justice*, *18*(3), 297–313. https://doi.org/10.1177/17461979221103779

Blanchet-Cohen, N., & Torres, J. (2024). Enhancing Citizen Engagement at the Municipal Level: Youth's Perspectives. In *Handbook of Children and Youth Studies* (2nd ed., pp. 459–472). https://doi.org/10.1007/978-981-99-8606-4_62

Bose, K., Martin, K., Walsh, K., Malik, M., Nyachae, P., Sierra, M. L., Bwire, A., Sama, D., Kiyola, T., Mitchell, V., Talla, H., Avoce, J., Graham, K., Sharma, M., Varghese, D., Ferrand, A., Igharo, V. I., & Akila, D. N. (2021). Scaling access to contraception for youth in Urban slums: The Challenge Initiative's Systems-Based Multi-Pronged Strategy for Youth-Friendly Cities. *Frontiers in Global Women S Health*, *2*. https://doi.org/10.3389/fgwh.2021.673168

Castelnovo, W., & Romanelli, M. (2020). Power relationships in the co-production of smart city initiatives. In *Lecture notes in information systems and organisation* (pp. 329–342). https://doi.org/10.1007/978-3-030-47539-0_22

Castilla, J. E. M., & Müller, A. R. (2023). A smart city for all citizens: an exploration of children's participation in Norway's smartest city. *International Planning Studies*, *29*(1), 19–33. https://doi.org/10.1080/13563475.2023.2259110

Choi, S. (2024). Industry Insights on Future Convergence Education: A survey of key competencies and educational directions. *2022 IEEE Global Engineering Education Conference (EDUCON)*, 1–3. https://doi.org/10.1109/educon60312.2024.10578909

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Pardo, T. A., & Scholl, H. J. (2012). Understanding Smart Cities: An Integrative Framework. In *Proceedings of the Annual Hawaii International Conference on System Sciences*. https://doi.org/10.1109/hicss.2012.615

Dali, M. M., Sharifi, A., & Adnan, Y. M. (2022). Envisioning sustainable and resilient Petaling Jaya through Low-Carbon and Smart City Framework. In *˜ The œurban book series* (pp. 213–238). https://doi.org/10.1007/978-3-030-95037-8_10

De Bem Machado, A., Santos, J. R. D., Sacavém, A., & Sousa, M. J. (2023). Digital Transformation: Management of smart cities. In *Emerald Publishing Limited eBooks* (pp. 59–83). https://doi.org/10.1108/978-1-80455-994-920231004

Demir, F. (2022). Smart cities. In *Public administration and information technology* (pp. 85–135). https://doi.org/10.1007/978-3-031-11331-4_3

Department of Standard Malaysia. 2021. MS ISO 37122:2019 Sustainable Cities and Communities – Indicators for Smart Cities. Cyberjaya: Department of Standard Malaysia.

Economic Planning Unit. (2021). *Rancangan Malaysia Kedua Belas 2021-2025*. Economic Planning Unit (EPU), Prime Minister Office.

Fiorani, G., Chiper, R. A., & Di Gerio, C. (2024). A comparative exploration of youth participation in local sustainable development: insights from Italian metropolitan cities. *International Journal of Public Sector Management*, *38*(3), 386–404. https://doi.org/10.1108/ijpsm-01-2024-0020

Giffinger, R., PhD, Fertner, C., Kramar, H., Kalasek, R., University of Ljubljana, & Delft University of Technology. (2007). Smart cities - Ranking of European medium-sized cities. https://www.smart-cities.eu/download/smart_cities_final_report.pdf

Gohari, S., Baer, D., Nielsen, B. F., Gilcher, E., & Situmorang, W. Z. (2020). Prevailing Approaches and Practices of Citizen Participation in Smart City Projects: Lessons from Trondheim, Norway. *Infrastructures*, *5*(4), 36. https://doi.org/10.3390/infrastructures5040036

Gruben, M., Sheil, A., Das, S., O'Keeffe, M., Camilleri, J., Cronin, M., & Murray, H. (2025). "It's Like Not Being Able to Read and Write": Narrowing the Digital Divide for Older Adults and Leveraging the Role of Digital Educators in Ireland. In *Proceedings of the 19th International Conference on Tangible, Embedded, and Embodied Interaction, TEI 2025* (pp. 1–15). https://doi.org/10.1145/3689050.3704945

Hermanus, D. R., Hermanus, D. R., Hidayat, F., & Supangat, S. H. (2024). Robust SmartCityAI Lakehouse: IKN (New Capital City of Indonesia) Case Study. In *11th International Conference on ICT for Smart*

Society: Integrating Data and Artificial Intelligence for a Resilient and Sustainable Future Living, ICISS 2024 (pp. 1–7). https://doi.org/10.1109/iciss62896.2024.10751179

Hollands, R. G. (2008). Will the real smart city please stand up? *City*, *12*(3), 303–320. https://doi.org/10.1080/13604810802479126

Jalaluddin, A. M., & Mohd Asruladlyi, I. (2015). Bandar selamat dan keselamatan komuniti bandar selamat. E-Bangi, 10(1), 97–117.

Karthikeyan, C. (2024). Integrating AI for resilient smart cities in India. In *Advances in computational intelligence and robotics book series* (pp. 183–216). https://doi.org/10.4018/979-8-3693-5918-1.ch007

Kougias, C., & Papadakaki, M. (2025). Rethinking the 'smart city': From technology-led visions to citizen-centered governance—barriers and pathways in digital urban initiatives. *Journal of Urban Affairs*, 1–24. https://doi.org/10.1080/07352166.2025.2502116

Krauss, S. E., Zeldin, S., Abdullah, H., Ortega, A., Ali, Z., Ismail, I. A., & Ariffin, Z. (2020). Malaysian youth associations as places for empowerment and engagement. *Children and Youth Services Review*, *112*, 104939. https://doi.org/10.1016/j.childyouth.2020.104939

Leybert, T. B., Khalikova, E. A., & Valinurova, L. S. (2022). Innovative transformations of higher education in the age of the digital economy. In *Advances in Science, Technology & Innovation/Advances in science, technology & innovation* (pp. 69–74). https://doi.org/10.1007/978-3-030-90324-4_11

Lim, S. B & Jalaludin, A. M. 2022. *Pembangunan Bandar Pintar Berpusatkan Rakyat di Malaysia.* Bangi: Penerbit Universiti Kebangsaan Malaysia.

Loss, S., Rocha, R., Cacho, N., & Lopes, F. (2024). Integrating urban Operation Center systems for enhanced smart city management and emergency response. *2022 IEEE International Smart Cities Conference (ISC2)*, 1–6. https://doi.org/10.1109/isc260477.2024.11004181

Makkonen, T., & Inkinen, T. (2024). Inclusive smart cities? Technology-driven urban development and disabilities. *Cities*, *154*, 105334. https://doi.org/10.1016/j.cities.2024.105334

Maltseva, D., Safonova, O., Dedul, A., Petrunina, M., & Tepina, S. (2021). Youth policy in the human capital management system: Russian practice. *E3S Web of Conferences*, *311*, 08014. https://doi.org/10.1051/e3sconf/202131108014

Masucci, M., Pearsall, H., & Wiig, A. (2019). The Smart City Conundrum for Social Justice: Youth perspectives on digital technologies and urban Transformations. *Annals of the American Association of Geographers*, *110*(2), 476–484. https://doi.org/10.1080/24694452.2019.1617101

McKoy, D. L., Eppley, A., & Buss, S. (2021). *Planning cities with young people and schools*. https://doi.org/10.4324/9781003141778

Meijer, A., & Bolívar, M. P. R. (2015). Governing the smart city: a review of the literature on smart urban governance. *International Review of Administrative Sciences*, *82*(2), 392–408. https://doi.org/10.1177/0020852314564308

Michael, F. L., & Salleh, S. F. (2023). National Sustainability Planning in Malaysia. In *Springer eBooks* (pp. 1331–1350). https://doi.org/10.1007/978-3-031-01949-4_87

Ministry of Youth and Sports. (2023). *MODEL PEMBANGUNAN BELIA MADANI 2030*.

Nusrat, M. A., Paul, S., & Bhushan, B. (2023). Practicle Coordination and Aspect of IoT for Smart Cities and Healthcare System. In *Proceedings of the 2023 12th International Conference on System Modeling and Advancement in Research Trends, SMART 2023* (pp. 280–287). https://doi.org/10.1109/smart59791.2023.10428643

Organisation for Economic Co-operation and Development (OECD). 2020. *The OECD Framework for Digital Talent and Skills in the Public Sector*. https://dx.doi.org/10.1787/4e7c3f58-en

Ozkaya, G., & Erdin, C. (2020). Evaluation of smart and sustainable cities through a hybrid MCDM approach based on ANP and TOPSIS technique. *Heliyon*, *6*(10), e05052. https://doi.org/10.1016/j.heliyon.2020.e05052

Picatoste, X., Novo-Corti, I., & Țîrcă, D. M. (2019). Smart cities to create opportunities for young people. In *Springer proceedings in complexity* (pp. 269–275). https://doi.org/10.1007/978-3-030-30809-4_25

Przeybilovicz, E., & Cunha, M. A. (2024). Governing in the digital age: The emergence of dynamic smart urban governance modes. *Government Information Quarterly*, *41*(1), 101907. https://doi.org/10.1016/j.giq.2023.101907

Putra, A. A., Makmur, N. M., Takdir, N. R. A., Wibowo, N. a. H., Ladianto, N. a. J., Munansar, N., Wulandari, N. N. R., & Nugraha, N. F. W. (2025). Towards a Sustainable City: Strategic Approach to Smart City Development. *Future Cities and Environment*, *11*. https://doi.org/10.70917/fce-2025-020

Rahman, A., Suryawan, I. W. K., Suhardono, S., Nguyen, V. V., & Lee, C. (2025). Determinants of electric vehicle adoption in urban and peri-urban areas. *Energy Sustainable Development/Energy for Sustainable Development*, *85*, 101664. https://doi.org/10.1016/j.esd.2025.101664

Rauhaus, B. M., & Guajardo, J. M. (2021). The practice of youth inclusion in community planning and resiliency: The case of Post-Hurricane Harvey. *Journal of Health and Human Services Administration*, *44*(1), 67–85. https://doi.org/10.37808/jhhsa.44.1.4

S, H. K., Kiran, P., S, M., Nilkant, D., & N, A. S. I. K. (2024). Technology's role in sustainable urban development in smart cities. In *Advances in human resources management and organizational development book series* (pp. 169–208). https://doi.org/10.4018/979-8-3693-3238-2.ch008

Sakil, A. H. (2017). ICT, youth and urban governance in developing countries: Bangladesh perspective. *International Journal of Adolescence and Youth*, *23*(2), 219–234. https://doi.org/10.1080/02673843.2017.1330697

Samsudin, N. A., Rosley, M. S. F., Lai, L. Y., Omar, S. R., Rashid, M. F., Rashid, M. F., Hanifi, N. S. N. M., & Bakhtiar, I. S. (2022). A COMPARATIVE STUDY OF SMART CITY INITIATIVES IN MALAYSIA: PUTRAJAYA AND ISKANDAR PUTERI. *PLANNING MALAYSIA*, *20*. https://doi.org/10.21837/pm.v20i24.1180

Shtebunaev, S., Gullino, S., & Larkham, P. J. (2023). Planning the Smart City with Young People: teenagers' perceptions, values and visions of smartness. *Urban Planning*, *8*(2). https://doi.org/10.17645/up.v8i2.6411

Simchenko, N. A., Astratova, G. V., & Klimuk, V. V. (2023). Creative human capital and assessment of its manifestation in organizational behavior in the context of digitalization higher education. *Perspectives of Science and Education*, *66*(6), 647–672. https://doi.org/10.32744/pse.2023.6.38

Simonofski, A., Vallé, T., Serral, E., & Wautelet, Y. (2019). Investigating context factors in citizen participation strategies: A comparative analysis of Swedish and Belgian smart cities. *International Journal of Information Management*, *56*, 102011. https://doi.org/10.1016/j.ijinfomgt.2019.09.007

Sowmiya, R., & Velavan, M. (2025). Leveraging emerging technologies for inclusive and sustainable urban governance. In *IGI Global eBooks* (pp. 111–136). https://doi.org/10.4018/979-8-3373-1375-7.ch004

Srivastava, R., & Sharifi, A. (2022). Smart Cities: concepts and underlying principles. In ˜ *The œurban book series* (pp. 39–65). https://doi.org/10.1007/978-3-030-95037-8_3

Symeonaki, M., Stamatopoulou, G., & Parsanoglou, D. (2025). Factors explaining adolescents' digital skills in Europe. *Humanities and Social Sciences Communications*, *12*(1). https://doi.org/10.1057/s41599-025-05241-9

T, R., G, R., D, J. B., Seshadri, V., & N, A. (2024). Relationship between Digital Learning, Digital Literacy and Academic Performance of Higher Education Students: Moderated Mediation Role of Critical Thinking. *International Research Journal of Multidisciplinary Scope*, *05*(03), 39–50. https://doi.org/10.47857/irjms.2024.v05i03.01054

Tahir, Z., Malek, J. A., & Ibrahim, M. A. (2016). Developing Smart ICT In Rural Communities in Malaysia through the

Establishment of Telecenters. Journal of Social Sciences and Humanities, 11, 227–242. https://doi.org/10.17576/ebangi.

Tcholtchev, N., & Schieferdecker, I. (2021). Sustainable and reliable information and communication technology for resilient smart cities. *Smart Cities*, *4*(1), 156–176. https://doi.org/10.3390/smartcities4010009

The Commissioner of Law Revision, Malaysia. (2014). Youth Societies and Youth Development. In *Laws of Malaysia*.

Tsipouri, L., & Liarti, S. (2022). The Co-Evolution of the digital transition and appropriate skills at city level. In *Internet of things* (pp. 21–36). https://doi.org/10.1007/978-3-030-97818-1_2

Turgel, I., Bozhko, L., Ulyanova, E., & Khabdullin, A. (2019). Implementation of the Smart City Technology for Environmental Protection Management of Cities: the experience of Russia and Kazakhstan. *Environmental and Climate Technologies*, *23*(2), 148–165. https://doi.org/10.2478/rtuect-2019-0061

Ulfik, A. (2024). Innovative and smart cities of the future. In *CRC Press eBooks* (pp. 19–40). https://doi.org/10.1201/9781003465157-2

United Nations Human Settlements Programme, Global Utmaning, Fabre, E. A., Martinuzzi, C., Levonen, T., Andersson, C., Petrella, L., Lahoud, C., Carbajal, P., Ang, J. C., Heng, B., Yonis, S., Smedberg, M., Wallén, C., Ziliani, G., Ukonu, M., Melin, T., Martinuzzi, C., Levonen, T., . . . Ahlström, T. (2022). Cities for Girls. In *Cities for Girls*.

Zeadat, Z. F. (2023). Strategies toward Greater Youth Participation in Jordan's Urban Policymaking. *Journal of Sustainable Real Estate*, *15*(1). https://doi.org/10.1080/19498276.2023.2204534