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Study on the application of wireless communication technology in digital communities in Guangdong

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ABSTRACT
In recent years, the integration of wireless communication technology has significantly influenced the evolution of digital communities. This study investigates the meaning, types, and characteristics of wireless communication technologies, explores their applications within digital communities, and identifies associated challenges and potential solutions. We employed a qualitative research methodology, concentrating on a rural district in Guangdong Province. We collected data through in-depth interviews and focus group discussions involving community members, local leaders, and technology experts. A semi-structured interview guide, reviewed by information technology specialists, ensured content validity. We applied thematic analysis to extract key themes and insights from the data. The findings reveal that wireless communication technologies, such as 5G and Bluetooth, are instrumental in enhancing connectivity and operational efficiency within digital communities. However, data security and privacy concerns remain significant obstacles. The study also underscores the importance of community engagement in implementing wireless technologies, highlighting the need for training and awareness programs. This research emphasizes the pivotal role of wireless communication technologies in shaping digital communities while addressing the necessity of robust security measures. We urge stakeholders to prioritize community involvement and education in order to maximize the benefits of these technologies. Future research should examine the long-term impacts of wireless technologies on social cohesion and evaluate the effectiveness of security protocols in safeguarding community data.

Introduction

The integration of wireless communication technology has revolutionized the operation, interaction, and growth of digital communities (Worapongpat & Phumin, 2024). Through advancements like mobile networks, Wi-Fi, and satellite communication, wireless technologies have enabled real-time, seamless interactions across geographical boundaries (Castells, 2014).

Wireless communication technology breaks traditional barriers to accessing digital communities. Devices such as mobile phones, tablets, and laptops, connected via wireless networks, allow users to engage with information, services, and platforms without relying on fixed-line infrastructure. This accessibility is especially transformative in rural or remote areas, bridging the digital divide and fostering inclusivity in the digital economy (Camp, 2011; Wang, Wu, & Chen, 2019).

For instance, wireless solutions like 4G, 5G, and satellite broadband have enabled communities with limited wired internet to access vital services, including online education, telemedicine, and e-commerce. These advancements democratize access to digital ecosystems, enhancing economic and social opportunities (Dutta, 2019; Wang, 2020).

The immediacy of wireless communication supports real-time interactions in digital communities. Tools such as messaging apps, video conferencing platforms (e.g., Zoom, Slack), and cloud-based collaboration systems enable individuals and groups to work together efficiently, regardless of location. This capability has transformed remote work, online education, and digital activism, making them more interactive and responsive (Goldsmith, 2005; Sureeporn, Worapongpat, Uswin, Vorachai, & Kunlayarat, 2024).

Wireless technology also underpins the Internet of Things (IoT), where devices such as sensors and automation systems collect and transmit real-time data. In smart cities, for example, wireless networks power traffic management, environmental monitoring, and public safety systems, contributing to improved quality of life (Sharma & Jindal, 2020). Similarly, in homes, wireless-enabled IoT devices optimize energy use, enhance security, and simplify household tasks (Gorski, 2018).

Moreover, wireless technology drives innovation in digital service delivery. Applications in sectors like e-health, e-commerce, and e-governance depend on the speed and ubiquity of wireless networks to offer seamless, mobile-friendly services (Priya & Worapongpat, 2024). For example, mobile payment systems like PayPal and Apple Pay thrive on wireless connectivity, and telehealth applications enable remote healthcare consultations, particularly benefiting underserved areas (Katz, 2017).

Despite its benefits, applying wireless communication technology presents challenges. Security is a significant concern, as wireless networks are more vulnerable to breaches than wired systems. Addressing these risks requires continuous innovation in encryption, authentication, and network monitoring (Maitree & Worapongpat, 2024; Rappaport, 2019).

Network congestion is another challenge, particularly in densely populated areas. Although advancements in 5G technology aim to mitigate this by increasing bandwidth and reducing latency, widespread adoption remains a gradual process (Li, Min, & Worapongpat, 2023). Additionally, digital inclusion issues persist, as affordability and access to devices continue to hinder equitable participation in digital cExpanding affordable wireless services, subsidizing devices, and promoting digital literacy are essential to overcome the challenges (Rheingold, 1993).gold, 1993).

In conclusion, wireless communication technology is pivotal to the evolution of digital communities, enhancing connectivity, enabling real-time communication, supporting IoT applications, and fostering innovation. Addressing challenges such as security, network congestion, and digital inclusion will be critical to fully realizing the transformative potential of wireless technology. Continuous improvements in infrastructure and equitable access policies will ensure that digital communities thrive in an increasingly connected world.

Objective

1. To explore the meaning, types, and characteristics of wireless communication technology
2. To examine the concept of digital communities and the application of wireless communication technology within them
3. To identify shortcomings and propose solutions for the application of wireless communication technology in digital communities

Literature review

Definition of Wireless Communication Technology

Wireless communication technology refers to the transmission of data between devices without physical connections. Chongwen and Worapongpat (2020) define it as encompassing methods such as radio waves, infrared signals, and satellite communications, enabling data transfer over varying distances (Worapongpat, Wongkumchai, & Anuwatpreecha, 2024).

Types of wireless communications

Wireless communication includes various forms, such as Wi-Fi, Bluetooth, LTE, and 5G, each serving distinct purposes. Chatchai and Worapongpat (2024) highlight Wi-Fi as commonly used for local area networks (LANs), while LTE and 5G offer broader coverage and faster data rates, enhancing connectivity on a larger scale.

Characteristics of Wireless Communication Technology

Key characteristics of wireless systems include mobility, flexibility, and ease of deployment. Chokchai (2024) emphasizes their ability to connect users from virtually any location. However, challenges such as signal interference and limited range persist.

Definition of a Digital Community

A digital community consists of individuals or groups interacting primarily through digital platforms to form relationships, share content, and collaborate online. Cai and Wongsawad (2024) introduced the concept, noting that these communities transcend physical boundaries to facilitate global connections.

Role of Wireless Communication in Digital Communities

Wireless technologies provide the backbone for seamless, real-time connectivity in digital communities. Dongling and Worapongpat (2023) argue that mobile internet access enables effortless communication and collaboration, fostering engagement and interaction across digital spaces (Worapongpat, 2024).

Impact of Wireless Technology on Community Development

Wireless communication technology bridges the digital divide, particularly in underserved areas. Hou and Phromphithakkul (2024) note its role in providing access to education, healthcare, and financial services in rural regions, fostering economic and social development (Worapongpat, Saengphukhaeo, Wongkhamchai, & Muangmee, 2023).

Challenges in Wireless Communication for Digital Communities

Despite its advantages, wireless communication faces challenges like bandwidth limitations, network congestion, and security vulnerabilities. He and Worapongpat (2023) explain that these issues can undermine the reliability and quality of services, especially in densely populated areas (Worapongpat, 2023).

Security and privacy issues

Security is a critical concern in wireless communication. Jianzh and Worapongpat (2020) highlight vulnerabilities such as hacking, data breaches, and unauthorized access, which pose risks to members of digital communities who rely on these systems for personal and professional interactions (Worapongpat, Yuwariya, & Chariya, 2023).

Innovation in wireless communication for digital communities

Advancements in technologies like 5G and IoT have transformed wireless communication. Kumar (2021) emphasizes that 5G enhances digital platforms with higher speeds and lower latency, enabling real-time interaction for large-scale communities (Xunan & Worapongpat, 2023).

Shortcomings of Wireless Communication Technologies

Despite progress, wireless communication technologies face shortcomings such as signal interference, data throttling, and inconsistent coverage. Liu and Worapongpat (2024) state that these issues are particularly pronounced in urban areas with high device densities.

Proposed Solutions to Improve Wireless Communication

Researchers Rice and Hagen (2010) propose solutions such as advanced encryption for enhanced security, network slicing in 5G to mitigate congestion, and mesh networks to improve coverage and reliability within digital communities.

Conceptual rramework

This study examines the application and challenges of wireless communication technology (WCT) in digital communities. The conceptual framework is structured around three primary components aligned with the research objectives. It aims to provide a systematic approach to investigating the influence of WCT on digital communities, the challenges encountered, and potential solutions.

1. Wireless Communication Technology (WCT): Definition, Types, and Characteristics

This component focuses on understanding the foundational aspects of wireless communication technology, including its types (e.g., Wi-Fi, Bluetooth, LTE, 5G) and unique characteristics (e.g., mobility, flexibility, coverage, signal interference). These insights form the basis for analyzing the role of WCT in enabling digital communities.

2. Digital Communities (DC): Definition and Usage of WCT

This component defines digital communities and explores how WCT facilitates interactions within these ecosystems. It examines how wireless connectivity enables collaboration, communication, and active participation, which are vital to understanding the transformative role of WCT in digital community environments.

3. Shortcomings and Solutions of WCT in Digital Communities

This component addresses the limitations and challenges of WCT in digital communities, such as security vulnerabilities, bandwidth limitations, and network congestion. It also investigates potential solutions to enhance the effectiveness and reliability of WCT, focusing on aspects like advanced encryption, improved network performance, and user-centric designs.

Conceptual Flow

Input: The study begins by exploring the core aspects of WCT, including its types and characteristics, to establish a foundational understanding.

Process: The research then examines how WCT is utilized in digital communities (DC), emphasizing its role in shaping interactions, collaboration, and community engagement.

Output: The study concludes by identifying the shortcomings of WCT in digital communities and proposing practical solutions to address these challenges, ensuring sustainable and efficient applications of the technology.

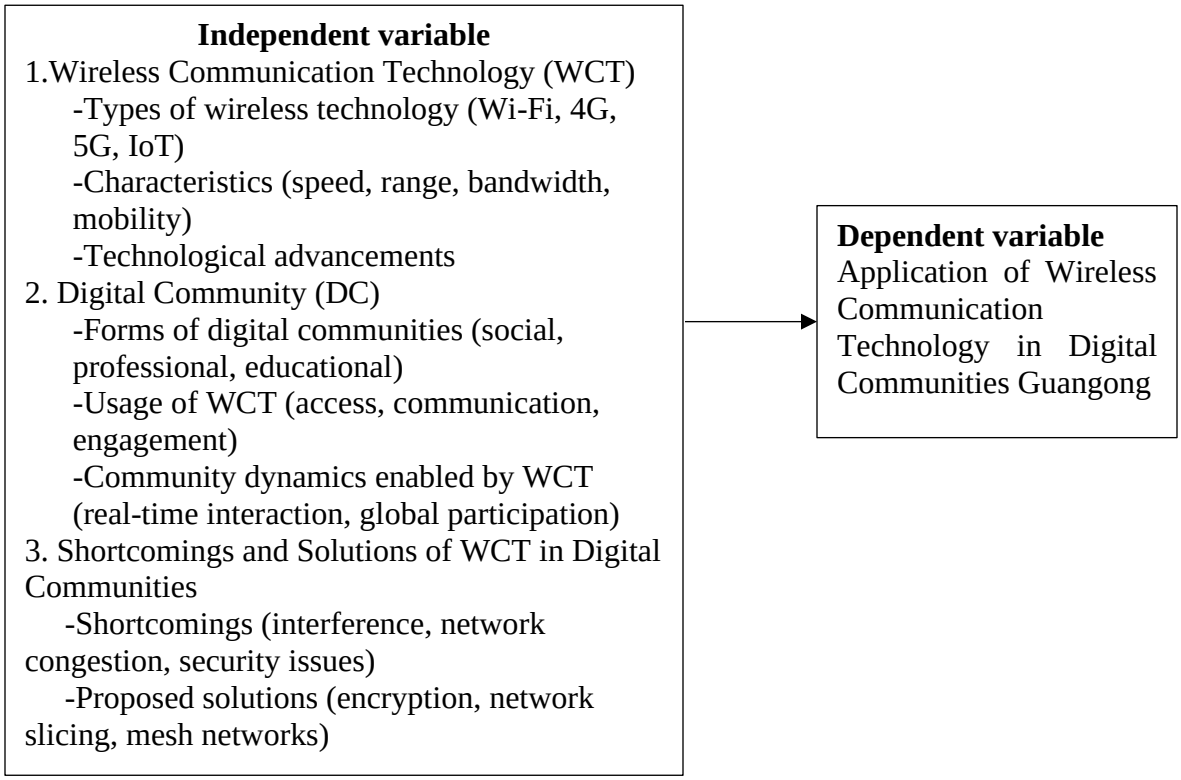

Figure 1 Research framework

Methods

This research employs a qualitative approach to explore the application and challenges of wireless communication technology in digital communities within a rural district in Guangdong, China. The methodology is structured to provide in-depth insights into the local context, enabling an understanding of the dynamics and issues surrounding wireless technology adoption in rural areas.

1. Research Approach A qualitative research approach was selected for this study, allowing for a detailed examination of wireless communication technology within the unique context of rural digital communities. This method facilitates an exploration of local usage patterns, challenges, and the impact of wireless technology in areas with limited urban infrastructure.

2. Research Area The study was conducted in a rural district in Guangdong Province, China, chosen for its unique technological development and potential for exploring both the benefits and limitations of wireless communication technology in less urbanized regions.

3. Population and Sample A purposive sampling method was employed due to the exploratory nature of the research. The sample comprised individuals and groups directly involved with or affected by wireless communication technology in the rural digital community. Participants included:

Key Informants: Local community leaders, technology users, small business owners, and technology service providers.

The final sample consisted of 20 participants (10 key informants, 10 community members), chosen

based on their direct experience with wireless communication technology. Data collection continued until data saturation was reached, meaning that no new insights or themes emerged from the interviews and observations.

4. Research Instruments The research utilized several instruments to gather comprehensive qualitative data: Semi-structured Interviews: Conducted with key informants, including local leaders, technology users, and small business owners, to capture their perspectives and experiences.

Focus Groups: Facilitated with community members to explore collective experiences and challenges regarding digital access and technology use.

Field Observations: Observations were made to assess the practical application of wireless technology in everyday life and business activities.

5. Data Collection The data collection process involved multiple techniques to ensure a holistic understanding of wireless communication technology in the rural context: Interviews: Semi-structured interviews were conducted to gather personal insights from key informants.

Focus Groups: Group discussions were held to capture community-wide perspectives.

Observations: Field observations were carried out to monitor how wireless technology was integrated into daily activities.

6. Data Analysis Thematic analysis was used to analyze the qualitative data. The interview and focus group transcripts were coded and categorized into key themes related to the use, challenges, and solutions for wireless communication technology in the community. NVivo software was used to assist with organizing and analyzing the large volume of qualitative data.

7. Validity and Reliability To ensure the rigor of the study, the following criteria were applied:

Content Validity: Expert reviews were conducted by professors specializing in Information Science from a Chinese university to ensure the questionnaire addressed the research objectives comprehensively. Based on their feedback, the questionnaire was revised for clarity and relevance.

Reliability: The reliability of the data collection instruments was ensured by triangulation. This involved using multiple data sources (interviews, focus groups, and observations) to cross-verify findings and enhance consistency. Additionally, peer debriefing was conducted, where academic colleagues reviewed and critiqued the data analysis process to improve the reliability of the interpretations.

Trustworthiness: Trustworthiness was further ensured through the continuous review and validation of findings by peers and experts. This allowed for confirming that the results reflected the participants' true experiences and perspectives.

8. Ethical Considerations Ethical approval was granted by the local authorities in Guangdong Province. Informed consent was obtained from all participants, ensuring that they understood their rights, the purpose of the study, and how their data would be used. Confidentiality was maintained by anonymizing participants' identities and protecting sensitive information.

9. Limitations The study faced several limitations:

Geographical and Infrastructural Barriers: Limited access to certain areas due to the rural nature of the district affected the research process.

Technology Familiarity: Some participants had limited exposure to advanced wireless technologies, which could have constrained the range of insights gathered.

10. Conclusion The methodology employed in this study allows for a deep, contextual exploration of wireless communication technology in a rural digital community. By utilizing a range of qualitative tools and ensuring the validity and reliability of instruments through expert review and triangulation, the research provides a thorough understanding of the role of wireless communication in rural community development.

Results

The research results are presented through the direct statements of key informants and observations, offering a clear reflection of the application, challenges, and solutions related to wireless communication

technology in the rural digital community in Guangdong, China. The findings are drawn from semi-structured interviews, focus group discussions, and field observations.

1. Key Informants' Statements Key informants, including local community leaders, technology users, small business owners, and technology service providers, shared their experiences and perspectives on the use of wireless communication technology. The following are some of their direct statements:

Community Leader: "Wireless communication has brought significant changes to our rural area. While it has connected us to the broader world, we still face challenges with unreliable signal strength during heavy rainfall."

Small Business Owner: "For my shop, having a stable internet connection is crucial. However, there are frequent interruptions during peak hours, which can frustrate customers."

Technology Service Provider: "We have been working to improve coverage, but remote areas still have limited access to high-speed internet. It's an ongoing issue that we're trying to solve."

These statements highlight the mixed experiences of the participants, ranging from benefits to challenges, with a strong emphasis on the need for improved infrastructure and stable connectivity.

2. Illustrations from Focus Group Discussions

During the focus group discussions, community members expressed a collective understanding of both the opportunities and limitations of wireless communication technology. The following quote illustrates this:

Focus Group Participant: "It’s wonderful to have access to information and services online, but many of us struggle with inconsistent connections. Some areas of the village have excellent coverage, while others have barely any signal."

The group discussed how wireless technology has improved their ability to access services, such as healthcare information and government updates, but they emphasized the need for more reliable and widespread coverage.

3. Field Observations Field observations revealed the practical application of wireless communication technology in the daily lives of community members. Some observations included:Residents using smartphones to access online services at local cafes, showing the widespread adoption of wireless technology.

Small businesses using wireless point-of-sale systems to improve efficiency and customer satisfaction, despite occasional connectivity issues.

Community gatherings where residents discussed digital literacy and shared tips on overcoming technology-related challenges.

These real-world examples illustrate the impact of wireless communication technology on community dynamics, providing a visual understanding of how technology is integrated into daily activities.

4. Themes from Data Analysis Thematic analysis of the interviews, focus groups, and field observations revealed several key themes related to the application of wireless technology:

Connectivity Issues: Despite the positive impact, many participants reported frequent disruptions and signal instability, particularly in remote areas.

Economic Opportunities: Wireless technology has enabled small businesses to expand their customer base by reaching online markets.

Digital Literacy and Awareness: A growing interest in improving digital skills was evident, with community members expressing the need for training and support in using advanced technologies.

5. Illustrative Example An illustrative example from the study involved a local entrepreneur, Mr. Li, who started selling handmade crafts online after receiving support from a community digital literacy program. His story exemplifies how wireless communication has opened up new economic opportunities: "Before the internet, I only sold my products locally. Now, with reliable wireless communication, I’ve expanded my business to customers in other provinces. The ability to market online has changed my life, but it’s frustrating when the signal drops in the middle of an online transaction."

This case shows both the potential for wireless communication to transform local economies and

the challenges that come with it.

The results of the study provide a rich and nuanced understanding of the role wireless communication technology plays in rural Guangdong. The direct statements of key informants, combined with illustrative examples from field observations and focus group discussions, offer valuable insights into both the positive impacts and the persistent challenges faced by rural communities in adopting wireless technology. Through these findings, it is evident that while wireless technology holds great promise for rural development, infrastructure improvements and digital literacy initiatives are crucial to realizing its full potential.

Discussion

The results of Research Objective 1, which aimed to explore the meaning, types, and characteristics of wireless communication technology, revealed that wireless communication encompasses a diverse range of technologies, including mobile phones, laptops, Bluetooth, 5G, and microwave wireless systems. These technologies facilitate data transmission without the need for physical cables and offer varying functionalities depending on their range and speed. For instance, Bluetooth technology is effective for short-range connections between personal devices, 5G provides high-speed data transfer suitable for real-time applications, and microwave communication supports long-distance data transmission. The evolution of wireless technology appears to have been driven by the need to address diverse connectivity demands, ranging from personal device communication to global information sharing. Each type of technology plays a distinct role in fulfilling communication requirements, whether for individual use or large-scale data transmission. These findings align with Zi Yun and Worapongpat (2023), as well as Zhao and Li (2020), who emphasize the versatility of wireless communication technologies and their broad application across various domains to support both local and global connectivity. The findings also correspond to Shen and Han's (2021) theory of wireless evolution, which underscores the importance of advancing technologies in enhancing efficient data transmission across multiple platforms. This is particularly significant for bridging communication gaps in both urban and rural communities.

The results of Research Objective 2, which aimed to explore the concept of a digital community and the role of wireless communication technology within these communities, revealed that the application of wireless technology significantly enhances their functionality. Wireless communication enables the efficient management of digital businesses and improves the accuracy of data transmission, resulting in more effective community operations. Furthermore, the integration of wireless technology in areas such as smart homes, smart shopping, and smart payment systems has notably improved quality of life by simplifying and streamlining day-to-day tasks. This can be attributed to the reliance of digital communities on seamless and flexible information transmission to sustain operations. Wireless technology facilitates this by offering solutions like wireless LANs (WLANs), which overcome the constraints of wired networks, providing greater mobility and flexibility. Additionally, the capability of wireless communication to optimize business operations enhances service delivery within digital communities. These findings correspond to the theory of the network society proposed by TianShu and Worapongpat (2022), which posits that wireless communication technologies serve as a foundational element in the development of modern digital communities. The results also align with the work of Ning, Worapongpat, Wongkumchai, Zidi, Jiewei, and Mingyu (2023), who demonstrated that wireless networks improve operational efficiency and foster social progress by integrating advanced technologies into everyday life.

The results of Research Objective 3, which aimed to explore the shortcomings of wireless communication technology in digital community applications and potential solutions, identified several critical challenges. While wireless technology offers numerous benefits, it also presents significant risks, particularly concerning data security. The transmission of data through public channels increases the vulnerability to information leakage and cybersecurity threats. However, the findings indicate that implementing advanced encryption protocols and secure network architectures can effectively mitigate

these risks and enhance data protection within digital communities. This challenge arises because wireless communication inherently relies on the transmission of data via electromagnetic and light waves, which are not confined to a secure physical medium. Consequently, safeguarding data privacy and security becomes a crucial concern in maintaining trust and functionality within digital communities. These results align with the research of Srinivasan and Moorthy (2018), which emphasizes the vulnerabilities of wireless networks and underscores the necessity of robust security measures to prevent data breaches. Similarly, the findings correspond to Maitree, C., and Worapongpat, N. (2024), whose studies highlight the importance of strong encryption methods in mitigating wireless communication risks. Furthermore, the findings resonate with Zhang, Y., and Lee, W. (2015), as well as Zhan, D., Wongkumchai, T., and Worapongpat, N. (2024), whose frameworks for wireless security advocate for regular updates to encryption standards and the adoption of multi-layered security systems to address the evolving threats associated with wireless communication technologies.

Originality and body of knowledge

From the study of Study on the application of wireless communication technology in digital communities in Guangdong found knowledge that can be summarized into a diagram.

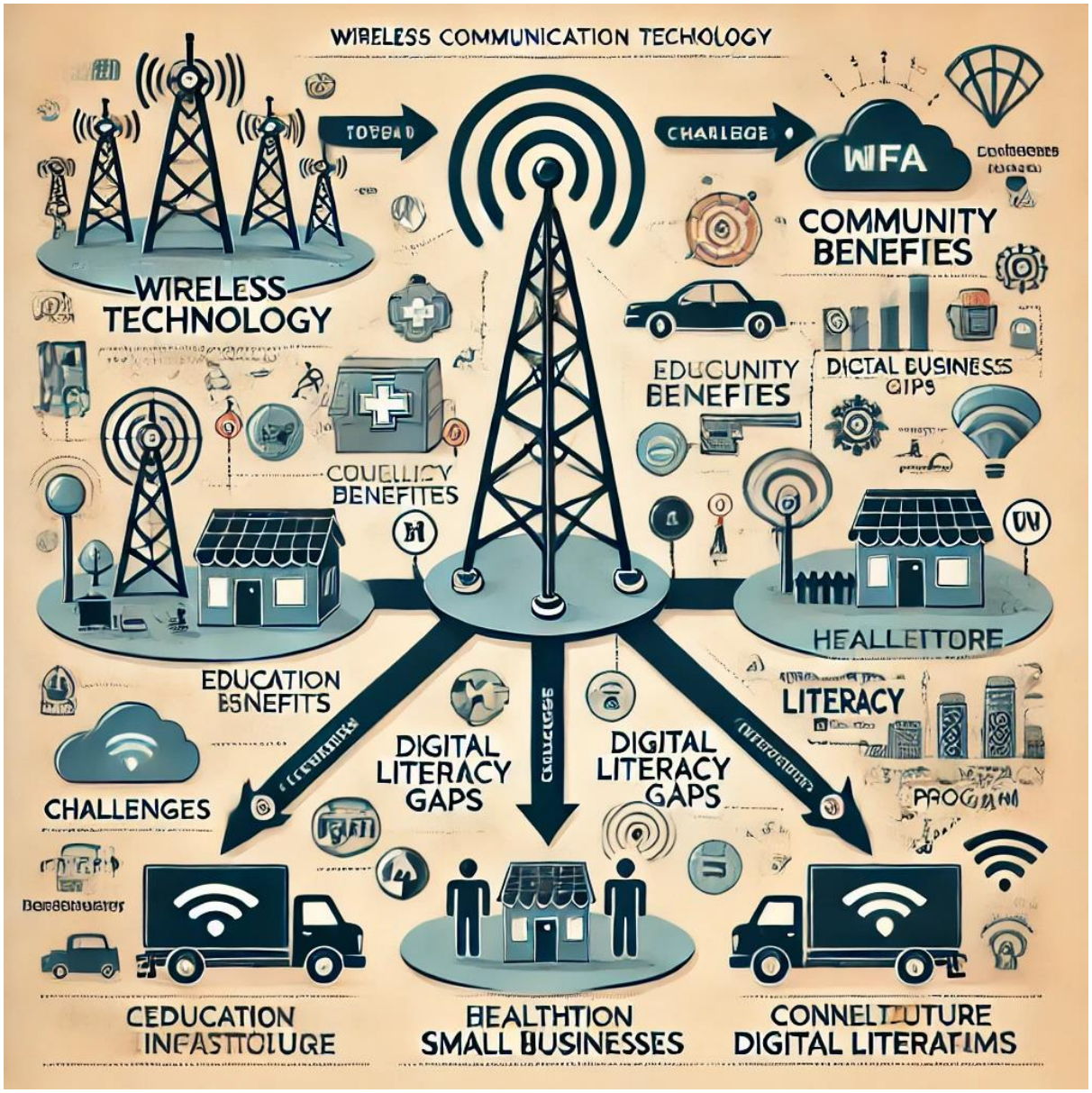

Diagram 2 shows the results of knowledge from the research.

The knowledge gained from this research study provides valuable insights into the application and challenges of wireless communication technology in rural communities in Guangdong Province, China. Below is a summary of the key research results presented in infographic format for better understanding:

1. Benefits of Wireless Communication Technology

Increased Connectivity: The study revealed that wireless technology has significantly improved access to online services, enhancing communication and information sharing.

Infographic: A diagram showing the percentage of community members who have access to different types of services (e.g., healthcare, education, e-commerce) via wireless technology.

Economic Growth for Small Businesses: Small business owners have benefited from reaching a wider customer base through online platforms, leading to increased sales and revenue.

Infographic: A bar chart comparing the growth of small businesses before and after adopting wireless technology.

2. Challenges of Wireless Communication Technology

Connectivity Issues: Many participants reported poor signal quality, especially in remote areas, which impacts the reliability of the technology.

Infographic: A map or chart highlighting areas with strong vs. weak signal coverage in the rural district.

Digital Literacy: While wireless technology has brought new opportunities, there is still a significant gap in digital literacy, limiting the effective use of available technologies.

Infographic: A pie chart showing the percentage of participants with basic, intermediate, and advanced digital skills.

3. Opportunities for Improvement

Infrastructure Development: Improved network infrastructure is crucial for overcoming connectivity issues.

Infographic: A flowchart illustrating the potential steps for enhancing wireless infrastructure, from government investment to community-driven initiatives.

Training and Support: There is a strong need for digital literacy programs to help residents and small business owners fully utilize wireless technology.

Infographic: A timeline showing the implementation stages of a digital literacy program in the community.

Suggestions

1. Suggestions for Applying Research Results

1.1 Results from Research Objective 1

The results from research objective 1, which aimed to study the meaning, types, and characteristics of wireless communication technology, found that various technologies such as Bluetooth, 5 G, and microwave communication play critical roles in enabling efficient data transmission. Therefore, relevant agencies should take action by investing in infrastructure to support these technologies, particularly in rural areas, to enhance connectivity and ensure equal access to communication resources. Additionally, training programs should be established to educate communities about the effective use of these technologies.

1.2 Results from Research Objective 2

The results from research objective 2, which aimed to study what a digital community is and how wireless communication technology is used in digital communities, found that wireless communication enhances the functionality of digital communities by improving data management and operational efficiency. Therefore, relevant agencies should take action by developing strategic plans that integrate wireless technologies into community planning and development initiatives. This includes establishing partnerships with tech companies to create smart community solutions that leverage wireless capabilities for better service delivery.

1.3 Results from Research Objective 3

The results from research objective 3, which aimed to study the shortcomings and solutions of wireless communication technology in digital community applications, found that data security risks associated with wireless communication pose significant challenges. Therefore, relevant agencies should take action by implementing robust cybersecurity measures and policies to safeguard sensitive data. This includes regular training for community members on best practices for online security and developing comprehensive protocols to address potential vulnerabilities in wireless networks.

2. Suggestions for Next Research

This research has found valuable knowledge regarding the application of wireless communication technology in digital communities. The important takeaway is that while wireless technology offers numerous advantages, it is essential to address the associated security challenges to maximize its potential benefits. This knowledge can be applied to enhance the design and implementation of digital community initiatives.

For the next research issue, it is suggested that studies should be conducted on the long-term impacts

of wireless communication technology on community engagement and social cohesion. Additionally, research should explore the effectiveness of different security measures in protecting data within wireless networks to provide a clearer understanding of best practices for safeguarding digital communities.

References

Cai, Q., & Wongsawad, T. (2024). Academic journal. *Journal of Education and Learning Reviews (JELS)*, 1(3), 1-10. https://so19.tci-thaijo.org/index.php/JELS/article/view/740

Camp, L. J. (2011). Security and privacy challenges in digital communication. *Journal of Network and Systems Management*, 19(4), 501-514.

Castells, M. (2014). *Networks of outrage and hope: Social movements in the Internet age.* Polity Press.

Chatchai, T., & Worapongpat, N. (2024). Guidelines for using information technology in the administration of educational institutions in the Ariyamongkol. *Journal of Administration, Management and Sustainable Development (JAMSD)*, 2(2), 453-462. https://so15.tci-thaijo.org/index.php/jamsd/article/view/758

Chongwen, G., & Worapongpat, N. (2020). The management of environmental design major at the undergraduate level of Shenyang City University in Shenyang, China. *Buddhamak Journal*, 7(2), 63-81.

Chokchai, P. (2024). The management of the Honest School Project in basic educational institutions Phra Chao Tak School Group under the Rayong Primary Educational Service Area Office, Area 1. *Buabundit Journal of Educational Administration*, 24(2), 132-144. https://so06.tci-thaijo.org/index.php/BUAJEAD/article/view/271438

Dongling, Z., & Worapongpat, N. (2023). Academic leadership of administrators influencing learning organization: A case study of the University of Hong Kong. *International Journal of Multidisciplinary in Educational & Cultures Studies*, 1(2), 12-20.

Dutta, S. (2019). Wireless network challenges in urban environments. *Wireless Communications*, 25(3), 34-40.

Goldsmith, A. (2005). *Wireless communications.* Cambridge University Press.

Gorski, P. (2018). Wireless technology in rural development. *Journal of Community Informatics*, 14(2), 115-128.

He, Z. Y., & Worapongpat, N. (2023). The impacts of new media on classroom teaching management of administrators in educational management: Taking Guangdong University as an example. *Journal of Multidisciplinary in Humanities and Social Sciences*, 6(1), 22-39. https://so04.tci-thaijo.org/index.php/jmhs1_s/article/view/260637

Hou, B., & Phromphithakkul, W. (2024). Relationship between perceived social support and university students' academic engagement in Shanxi, China: The chain mediating effect of academic buoyancy and academic engagement. *Nakhon Ratchasima College Journal of Humanities and Social Sciences*, 18(1), 269-284.

Jianzh., X., & Worapongpat, N. (2020). Adaptability of freshmen in Dalian Luxun Academy of Fine Arts. *Buddhamak Journal*, 7(2), 51-62.

Katz, M. (2017). Wireless communication systems: Types and applications. *IEEE Communications Magazine*, 55(7), 25-30.

Kumar, A. (2021). Wireless communication technologies: A comprehensive overview. *Journal of Communications and Networks*, 23(4), 293-307. https://doi.org/10.1109/JCN.2021.000034

Liu, J., & Worapongpat, N. (2024). Rural head teachers' leadership in local education curriculum under the perspective of educational modernization in Xi'an Province. *Journal of Interdisciplinary Social Development*, 2(3), 1-25.

Maitree, C., & Worapongpat, N. (2024). The use of innovation and information technology for school administration in the 21st century by administrators of Bangchak Prachachanikhom School Group and Wat Subannimit. *Journal of Liberal Arts (Wang Nang Loeng)*, 4(1), 59-71. https://so07.tci-thaijo.org/index.php/LiberalJ/issue/view/463/441

Min, Y., & Worapongpat, N. (2023). Creative leadership and school of Zhonghar Vocational and Technical College. *International Journal of Multidisciplinary in Educational & Cultures Studies*, 1(1), 1-13.

Ning, L., Worapongpat, N., Wongkumchai, T., Zidi, X., Jiewei, W., & Mingyu, Z. (2023). Administration of music courses for sustainable success: Case study of Jiangling Town Central High School, Dazhou City. *UBRU International Journal*, 3(2), 21-39.

Priya, S., & Worapongpat, N. (2024). Guidelines for the development of plant design and layout systems for applied industries and CPT industries. *Academic Journal Eastern Institute of Technology Suvarnabhumi*, 3(1), 41-47. https://so09.tci-thaijo.org/index.php/JEITS/article/view/2208

Rappaport, T. S. (2019). *Wireless communications: Principles and practice.* Pearson Education.

Rheingold, H. (1993). *The virtual community: Homesteading on the electronic frontier.* Addison-Wesley.

Rice, R. E., & Hagen, I. (2010). Social interaction in digital communities. *New Media & Society*, 12(8), 1383-1399.

Sharma, R., & Jindal, R. (2020). The evolution of wireless communication: A systematic review. *International Journal of Wireless Information Networks*, 27(2), 103-119. https://doi.org/10.1007/s10776-020-00440-0

Shen, X., & Han, S. (2021). Enhancing wireless communication for digital communities. *IEEE Wireless Communications*, 28(1), 12-18.

Srinivasan, R., & Moorthy, A. (2018). Data security in wireless networks: A survey of existing protocols and future directions. *Journal of Information Security and Applications*, 40, 21-34. https://doi.org/10.1016/j.jisa.2018.09.001

Sureeporn, T., Worapongpat, N., Uswin, C., Vorachai, V., & Kunlayarat, L. (2024). Participation of teachers in the administration of educational institution administrators. *Asian Education and Learning Review*, 2(2), 45-52.

TianShu, M., & Worapongpat, N. (2022). The hybrid teaching management system on art education subjects in Haizhou Senior Middle School of Fuxin City. *UBRU International Journal*, 3(1), 25-37.

Wang, Y. (2020). 5G and IoT in digital communities: A future vision. *IEEE Internet of Things Journal*, 7(9), 7801-7812.

Wang, Z., Wu, Y., & Chen, L. (2019). The impact of wireless communication on digital community development. *Telematics and Informatics*, 43, 101251. https://doi.org/10.1016/j.tele.2019.101251

Worapongpat, N. (2023). The transformation leadership administration of FIT Middle School in Anhui Province. *International Journal of Multidisciplinary in Cultures & Religions Studies*, 1(1), 14-27. https://so04.tci-thaijo.org/index.php/ijec/article/view/265805

Worapongpat, N. (2024). Guidelines for managing IoT systems to develop innovation management of teaching and learning in private higher education institutions in Thailand. *Journal of Educational Administration and Innovation*, 7(2), 1-18. https://so01.tci-thaijo.org/index.php/emi/article/view/263990

Worapongpat, N., & Phumin, Y. (2024). Academic journal. *Sri Suvarnabhumi Paritharn*, 2(2), 1-12.

Worapongpat, N., Wongkumchai, T., & Anuwatpreecha, T. (2024). Academic journal. *Journal of Education and Learning Reviews (JELS)*, 1(2), 1-12. https://so19.tci-thaijo.org/index.php/JELS/article/view/675

Worapongpat, N., Saengphukhaeo, N., Wongkhamchai, T., & Muangmee, C. (2023). Exploring digital marketing strategies on online social media and developing brand and product lab. *Journal of*

Value Chain Management and Business Strategy, 2(4), 61-74. https://so08.tci-thaijo.org/index.php/VCMBS/article/view/2030

Worapongpat, N., Yuwariya, R., & Chariya, W. (2023). Digital leadership of school administrators in Chanthaburi, Chonburi, and Bangkok. *Journal of Education, Panyapat, Surin Rajabhat University (JEDU-SRRU)*, 1(2), 125-148. https://so08.tci-thaijo.org/index.php/JEDU-SRRU/article/view/2115

Xunan, L., & Worapongpat, N. (2023). The transformation leadership administration of FIT Middle School in Anhui Province. *International Journal of Multidisciplinary in Educational & Cultures Studies*, 1(1), 14-27.

Zhang, Y., & Lee, W. (2015). Security issues in wireless communication for digital platforms. *Wireless Networks*, 21(2), 175-188.

Zhan, D., Wongkumchai, T., & Worapongpat, N. (2024). The factors affecting effective organizational culture management: A case study of Hongfu Company in China. *Journal of International Buddhist Studies College (JIBSC)*, 10(1), 80-95. https://so03.tci-thaijo.org/index.php/ibsc/article/view/273736

Zhao, X., & Li, J. (2020). Securing wireless communication: Challenges and solutions. *IEEE Communications Surveys & Tutorials*, 22(1), 389-409. https://doi.org/10.1109/COMST.2019.2956795

Zi Yun, H., & Worapongpat, N. (2023). The impacts of new media on classroom teaching management of administrators in educational management: Taking Guangdong University as an example. *Journal of Multidisciplinary in Humanities and Social Sciences*, 6(1), 22-39.