Impact of Technology Access on Youth Innovation Capabilities Among Young People in Bungoma South Sub-County

FLORENCE WANJALA
Department of Psychology, Kibabii University

Abstract- This study examines the state of digital literacy and its impact on youth innovation in Bungoma South Sub-County, Kenya. Using a mixed-method approach, the research investigated technology access patterns, digital skills development, and innovation outcomes among youth aged 15-35 years. Data was collected from 384 youth participants, 24 instructors, and 16 administrators through surveys, semi-structured interviews, focus group discussions, and observational assessments. The findings reveal that while mobile device penetration is relatively high (68.5% smartphone access), significant gaps exist in advanced digital skills, with only 11.8% of youth achieving intermediate programming proficiency. The study identified critical barriers including limited infrastructure (42% 4G coverage), inadequate training resources, and funding challenges (78.5% reporting access difficulties). However, successful digital literacy programs demonstrated substantial positive outcomes, with participants experiencing a 45.2% increase in income levels and improved employment rates (23.3% increase). AgriTech and EdTech initiatives showed particularly promising results, with sustainability rates of 35.7% and 31.3% respectively. The research contributes to understanding the relationship between digital literacy, youth innovation, and economic development in rural and semi-urban contexts, offering evidence-based recommendations for policy makers, educational institutions, and community stakeholders. These findings inform strategies for enhancing digital literacy and fostering youth innovation in similar developing regions.

Indexed Terms- Impact, Technology Access, Innovation Capabilities, Young People

I. INTRODUCTION

The rapid evolution of digital technology in the 21st century has fundamentally transformed the landscape of education and skills development globally. According to the World Economic Forum (2023), over 60% of global GDP is expected to be digitized by 2025, necessitating comprehensive digital literacy among youth populations. The integration of digital tools and platforms into educational systems has created new opportunities for learning while simultaneously presenting challenges for regions with limited technological infrastructure (UNESCO, 2022). This digital transformation has particularly impacted developing nations, where the struggle to bridge the technological gap becomes increasingly crucial for economic competitiveness.

Bungoma South Sub-County, located in western Kenya, represents a microcosm of the challenges and opportunities facing developing regions in the digital age. With a population of approximately 280,000 people, of which 60% are under the age of 35 (Kenya National Bureau of Statistics, 2023), the sub-county exhibits significant potential for digital innovation and economic growth. However, the region faces considerable challenges in terms of technological infrastructure and access. Recent surveys indicate that only 45% of the population has regular access to digital devices and internet connectivity (Communications Authority of Kenya, 2023), highlighting the substantial gap between digital potential and current reality.

The Kenyan government has recognized the importance of digital literacy through various initiatives and policies. The Digital Literacy Programme (DLP), launched in 2016, aims to enhance digital skills among young learners across the country.

Additionally, the Kenya Vision 2030 framework emphasizes technology as a key driver of economic development (Ministry of ICT, 2022). Despite these initiatives, implementation challenges persist, particularly in rural and semi-urban areas like Bungoma South Sub-County. The National ICT Policy (2023) acknowledges these challenges while outlining strategies to enhance digital infrastructure and skills development programs.

Youth participation in technological innovation has become increasingly critical for economic development in Kenya and similar developing nations. Research by the African Development Bank (2023) indicates that countries with higher youth digital literacy rates demonstrate stronger economic growth indicators and increased entrepreneurship activities. In Bungoma South Sub-County, emerging tech hubs and innovation centers have begun to showcase the potential of youth-driven digital transformation, though these initiatives remain limited in scope and reach (Kenya Innovation Agency, 2023).

The global digital divide continues to present significant challenges for developing regions, with implications extending beyond mere technology access. The International Telecommunication Union (2023) reports that while 87% of developed countries' populations have internet access, only 47% of developing countries' populations enjoy similar connectivity. This disparity affects educational opportunities, economic participation, and innovation potential among youth populations. In Kenya, and specifically in regions like Bungoma South Sub-County, addressing this digital divide has become crucial for ensuring equitable access to digital opportunities and fostering youth innovation (World Bank Digital Development Partnership, 2023).

II. THEORETICAL FRAMEWORK

This study is anchored in five complementary theoretical frameworks. The Digital Divide Theory (Norris, 2001; Van Dijk, 2020) conceptualizes three crucial gaps: global divide between industrialized and developing nations, social divide within nations, and democratic divide in digital resource utilization. Social Cognitive Theory (Bandura, 1986) emphasizes observational learning and self-efficacy in skill development, particularly relevant to digital competency acquisition.

III. LITERATURE REVIEW

- Digital Literacy in Developing Regions

The concept of digital literacy has evolved significantly over the past decade, moving beyond basic computer skills to encompass a broader range of competencies. According to UNESCO's Digital Literacy Global Framework (2022), digital literacy now includes information literacy, media literacy, and data literacy as essential components. Studies by Martin and Grudziecki (2020) define digital literacy as "the awareness, attitude, and ability of individuals to appropriately use digital tools and facilities to identify, access, manage, integrate, evaluate, analyze, and synthesize digital resources." This expanded definition has particular relevance in developing regions, where the challenge lies not just in providing access to technology but in building comprehensive digital competencies.

Current trends in digital literacy education in developing regions show a shift toward mobile-first approaches and contextualized learning. Research by the International Telecommunication Union (2023) indicates that mobile devices serve as the primary gateway to digital literacy for 78% of users in developing countries. A comparative study by Oladapo and Rahman (2022) examining digital literacy initiatives across Sub-Saharan Africa found that countries implementing integrated digital literacy programs within their formal education systems showed significantly higher rates of digital competency among youth. Examples from Rwanda's Digital Ambassadors Program and Ghana's Mobile Digital Skills Training Initiative demonstrate successful models of contextually relevant digital literacy education.

Analysis of digital literacy programs across developing regions reveals varying approaches and success rates. A World Bank study (2023) comparing digital literacy levels in Southeast Asia, Latin America, and Africa found that successful programs share common characteristics: strong policy frameworks, sustained funding mechanisms, and partnerships between government, private sector, and

educational institutions. However, research by Kumar and Singh (2023) highlights persistent challenges in implementing these programs, including inadequate infrastructure, limited teacher training, and cultural barriers to technology adoption.

- Youth Innovation and Technology

Technology plays a pivotal role in fostering youth innovation across developing regions. Research by the African Development Bank (2023) demonstrates that access to digital tools and platforms has led to a 45% increase in youth-led startups across the continent. Studies by Chen and Li (2022) identify key factors that enable youth innovation through technology: access to digital resources, mentorship opportunities, and supportive innovation ecosystems. The relationship between digital literacy and innovation capability has been well-documented, with research showing that digitally literate youth are three times more likely to engage in entrepreneurial activities.

Success stories and case studies from developing regions provide valuable insights into effective approaches to fostering youth innovation. The M-PESA revolution in Kenya, as analyzed by Ndemo and Weiss (2023), demonstrates how youth-driven technological innovation can transform entire economies. Similar success stories emerge from innovation hubs in Nigeria, Uganda, and Tanzania, where digital literacy programs have directly contributed to youth entrepreneurship. However, Kimani et al. (2023) note that these success stories often cluster around urban centers, highlighting the need for more inclusive innovation ecosystems.

- Technology Access and Infrastructure

The current state of ICT infrastructure in developing regions presents a complex picture of progress and persistent challenges. A comprehensive survey by the International Telecommunication Union (2023) reveals that while mobile network coverage has reached 85% in developing countries, reliable broadband internet access remains limited to 47% of the population. In Kenya specifically, the Communications Authority (2023) reports significant regional disparities in ICT infrastructure distribution, with rural areas particularly underserved.

Public and private initiatives to enhance technology access show varying degrees of success. The Digital Kenya Programme, analyzed by Mutua and Johnson (2023), demonstrates how public-private partnerships can effectively expand digital infrastructure. Similar initiatives in Tanzania, Uganda, and Rwanda provide comparative insights into successful infrastructure development models. However, research by Peterson et al. (2023) identifies persistent challenges in sustaining these initiatives, including funding constraints, maintenance issues, and coordination difficulties between stakeholders.

- Skills Development Programs

The landscape of digital skills development programs in developing regions shows increasing sophistication and adaptation to local contexts. Research by Thompson and Okoro (2023) evaluates the impact of various training approaches, finding that programs combining practical skills with entrepreneurship training show the highest success rates. The study of existing training programs across Africa by the African Centre for Technology Studies (2023) identifies key success factors: sustained engagement, practical application opportunities, and strong links to employment opportunities.

Best practices in digital skills development, as documented by the World Economic Forum (2023), emphasize the importance of adaptive learning approaches and industry alignment. Studies by Liu and Ahmed (2023) highlight successful models from Asia and Africa, where skills development programs have effectively bridged the gap between education and employment. These programs typically incorporate elements of peer learning, mentorship, and practical project work.

Educational institutions play a crucial role in digital skills development, though their effectiveness varies significantly. Research by Edwards and Mwangi (2023) examining the role of technical and vocational institutions in digital skills development finds that successful programs share common characteristics: updated curricula, qualified instructors, and strong industry partnerships. However, studies also identify significant challenges, including resource constraints, outdated equipment, and limited industry engagement opportunities.

IV. METHODOLOGY

- Research Design

This study employs a mixed-method research design, combining quantitative and qualitative approaches to provide a comprehensive understanding of digital literacy and youth innovation in Bungoma South Sub-County. The cross-sectional design allows for data collection at a single point in time, providing a snapshot of current digital literacy levels, access to technology, and innovation practices among youth. This approach aligns with similar studies conducted by Hassan and Kumar (2023) in developing regions, enabling comparative analysis while maintaining methodological rigor. The mixed-method design facilitates both statistical analysis of digital literacy trends and in-depth exploration of youth experiences with technology and innovation.

- Target Population

The study targets youth aged 15-35 years residing in Bungoma South Sub-County, with an estimated total population of 168,000 youth based on the Kenya National Bureau of Statistics (2023) data. This population spans secondary school students, college students, employed youth, and young entrepreneurs. The study also includes 12 educational institutions (4 secondary schools, 3 technical training institutes, and 5 colleges), 8 registered technology training centers, and 4 youth innovation hubs operating within the sub-county. These institutions were selected based on their involvement in digital skills development and youth empowerment programs. The diverse target population ensures comprehensive coverage of different youth segments and their varying experiences with digital literacy and innovation.

- Sampling Techniques

A multi-stage stratified random sampling technique is employed to ensure representative sample selection. The sample size is determined using Yamane's formula (1967) with a 95% confidence level and 5% margin of error:

$$n = N/(1 + N(e)^2)$$

where n is the sample size, N is the population size, and e is the margin of error. Based on this calculation, the study targets 384 youth respondents. The population is stratified based on age groups (15-20, 21-25, 26-30, 31-35), educational level, and geographical location within the sub-county. From educational institutions and training centers, a purposive sampling of 24 instructors and 16 administrators is included to provide institutional perspectives. Selection criteria include: minimum one-year residence in the sub-county, active engagement in education or employment, and willingness to participate in the study.

- Data Collection Methods

The study implements a comprehensive data collection strategy incorporating multiple methods. Primary quantitative data is collected through structured questionnaires administered to youth participants, focusing on digital literacy levels, technology access, and innovation practices. The questionnaire is adapted from the UNESCO Digital Literacy Global Framework (2023) and validated through pilot testing with 30 respondents. Semi-structured interviews are conducted with 40 key informants, including educators, technology trainers, and innovation hub managers, using an interview guide developed based on the research objectives.

- Focus group discussions (FGDs) are organized with eight groups of 8-12 participants each, stratified by age and gender to ensure diverse perspectives. These discussions explore barriers to digital literacy, innovation experiences, and potential solutions. Non-participant observation is conducted at educational institutions and innovation hubs using a structured observation checklist to assess available technology infrastructure and utilization patterns. Document analysis covers institutional records, training materials, and policy documents related to digital literacy programs in the region.

- Data Analysis

Quantitative data analysis employs both descriptive and inferential statistical techniques using SPSS version 27.0. Descriptive statistics include frequencies, percentages, means, and standard deviations to summarize digital literacy levels and technology access patterns. Inferential statistics, including chi-square tests, correlation analysis, and multiple regression, are used to examine relationships

between variables and test hypotheses about factors influencing digital literacy and innovation capacity.

Qualitative data undergoes thematic analysis using NVivo 13 software, following Braun and Clarke's (2021) six-step framework: familiarization with data, initial coding, theme development, theme review, theme definition, and report writing. The analysis focuses on identifying recurring patterns, themes, and relationships in participants' experiences and perspectives. Content analysis is applied to documentary evidence to identify trends and patterns in digital literacy programming and implementation.

Data triangulation methods are employed to enhance validity and reliability. This includes methodological triangulation (comparing data from different collection methods), source triangulation (comparing perspectives from different participant groups), and analyst triangulation (involving multiple researchers in the analysis process). The integration of quantitative and qualitative findings occurs at both analysis and interpretation stages, providing a comprehensive understanding of digital literacy and youth innovation in the study area.

V. RESULTS AND DISCUSSION

- Technology Access

The study findings reveal varying levels of technology access among youth in Bungoma South Sub-County. Analysis of the surveyed population (n=384) indicates significant disparities in digital device ownership and internet connectivity.

Table 1: Digital Device Ownership Among Youth
Analysis of digital device ownership reveals that smartphones dominate as the primary device among youth in Bungoma South Sub-County, with 68.5% of respondents having access to smartphones either as primary (45.2%) or secondary (23.3%) users. This high percentage reflects the mobile-first nature of digital access in the region. However, access to more sophisticated devices such as laptops (32.3%) and tablets (15.8%) remains relatively low, potentially limiting youth engagement in more complex digital tasks and content creation. The low percentage of desktop computer access (12.4%) suggests limited availability of traditional computing facilities, which

could impact the development of certain professional digital skills.

Device Type	Percentage (%)	Primary Users	Secondary Users
Smartphones	68.5	45.2	23.3
Laptops	32.3	18.7	13.6
Tablets	15.8	8.4	7.4
Desktop Computers	12.4	5.2	7.2

Table 2: Internet Connectivity Patterns

Internet connectivity data demonstrates a heavy reliance on mobile data (72.6%) as the primary means of internet access, with users averaging 4.2 hours of daily usage. The relatively low presence of home Wi-Fi connections (23.4%) despite longer average daily usage (6.8 hours) indicates that while stable home connections are preferred, they remain inaccessible to most youth. Cyber cafés serve as significant access points (45.2%), though with limited daily usage (2.1 hours), suggesting they function as supplementary access points. Institutional access through schools (38.7%) shows moderate availability but could be better utilized beyond the current 3.5 hours average daily usage.

Access Type	Availability (%)	Average Daily Usage (hours)
Mobile Data	72.6	4.2
Home Wi-Fi	23.4	6.8
Cyber Café	45.2	2.1
School/Institution	38.7	3.5

Infrastructure assessment reveals that 65% of the surveyed areas have mobile network coverage, though only 42% have consistent 4G access. Public internet access points are available in 28% of the studied locations.

Digital Skills Assessment
The evaluation of digital skills among youth participants demonstrates varying proficiency levels across different competency areas.

Table 3: Digital Competency Levels

Analysis of digital competency levels reveals a clear pyramid structure in skill distribution. Basic information navigation and communication tools show high proficiency rates (82.3% and 88.5% respectively), reflecting youth comfort with fundamental digital tasks. However, there is a significant drop in intermediate and advanced skills across all categories. Particularly concerning is the low proficiency in problem-solving (28.7% intermediate, 6.5% advanced) and programming (22.4% basic, 11.8% intermediate, 3.2% advanced), suggesting a critical gap in higher-order digital skills necessary for innovation and technological development. Content creation skills show moderate basic proficiency (65.7%) but limited advanced capabilities (8.9%), indicating a need for more focused training in this area.

Skill Category	Basic (%)	Intermediate (%)	Advanced (%)
Information Navigation	82.3	45.6	12.4
Content Creation	65.7	32.4	8.9
Communication Tools	88.5	52.3	15.6
Problem-Solving	58.9	28.7	6.5
Programming	22.4	11.8	3.2

Table 4: Training Program Effectiveness

The effectiveness of training programs shows varying success rates across different digital skill levels. Basic Digital Literacy programs demonstrate the highest enrollment (245 participants) and completion rates (82.4%), indicating strong interest and accessibility of foundational digital education. However, the employment rate for these programs (45.6%) suggests a gap between basic digital literacy and market demands. Advanced Computing and Programming courses show lower enrollment numbers (156 and 98 respectively) but higher employment rates (52.3% and 61.8%), indicating that while these programs attract fewer participants, they tend to lead to better employment outcomes. Digital Marketing courses show promising results with moderate enrollment (134) and relatively high employment rates (58.4%), suggesting a growing demand for these skills in the local market.

Program Type	Enrollment	Completion Rate (%)	Employment Rate (%)
Basic Digital Literacy	245	82.4	45.6
Advanced Computing	156	68.5	52.3
Programming Courses	98	55.1	61.8
Digital Marketing	134	73.9	58.4

Skills gap analysis identified critical areas requiring attention, particularly in advanced digital competencies and emerging technologies.

- Innovation Indicators

Assessment of innovation initiatives and outcomes reveals emerging patterns in youth entrepreneurship and digital solution development.

Table 5: Innovation Project Categories and Success Rates

The distribution of innovation projects across different sectors reveals interesting patterns in youth entrepreneurship preferences and success rates. AgriTech projects, while fewer in number (28), demonstrate the highest success (42.9%) and sustainability rates (35.7%), possibly due to the region's strong agricultural base and clear market need. EdTech solutions follow closely with 40.6% success rate, reflecting the growing demand for educational technology. E-commerce initiatives, despite having the highest number of projects (45), show moderate success rates (35.6%), suggesting high interest but significant market challenges. The relatively lower numbers in Health Tech (19 projects) but comparable success rates (36.8%) indicate potential opportunities for growth in this sector.

Project Category	Number of Initiatives	Success Rate (%)	Sustainability Rate (%)
E-commerce	45	35.6	28.9
EdTech Solutions	32	40.6	31.3
AgriTech	28	42.9	35.7
FinTech	23	34.8	26.1

Project Category	Number of Initiatives	Success Rate (%)	Sustainability Rate (%)
Health Tech	19	36.8	31.6

Table 6: Innovation Challenges and Support Systems
Analysis of innovation challenges reveals funding access as the most prevalent barrier (78.5%) with limited available support (32.4%) and low effectiveness rating (2.8/5). Technical skills emerge as the second most significant challenge (65.3%), though with better support systems in place (45.6%) and higher effectiveness rating (3.2/5). The data suggests a critical gap between the challenges faced and the support available, particularly in funding and market access. Mentorship shows the highest effectiveness rating (3.5/5) despite moderate availability (41.2%), indicating that existing mentorship programs are working well but need expansion to reach more youth innovators.

Challenge Type	Prevalence (%)	Available Support (%)	Effectiveness Rating
Funding Access	78.5	32.4	2.8/5
Technical Skills	65.3	45.6	3.2/5
Market Access	58.9	38.7	3.0/5
Mentorship	52.4	41.2	3.5/5

Impact Analysis
The study evaluated multiple dimensions of impact resulting from digital literacy initiatives and innovation programs.

Table 7: Economic Impact Indicators
The economic impact analysis demonstrates significant positive outcomes from digital literacy and innovation initiatives. Employment rates show a substantial increase from 35.6% to 58.9%, representing a 23.3% improvement. The most notable impact is seen in income levels, with a 45.2% increase post-program participation. Business creation doubled from 12.4% to 28.7%, indicating that digital skills are enabling youth entrepreneurship. The dramatic rise in freelancing activity (from 18.9% to 42.3%) suggests that digital skills are opening new remote work opportunities for youth in the region, creating alternative income streams beyond traditional employment.

Impact Category	Pre-Program (%)	Post-Program (%)	Change (%)
Employment Rate	35.6	58.9	+23.3
Income Level	-	-	+45.2
Business Creation	12.4	28.7	+16.3
Freelancing Activity	18.9	42.3	+23.4

Table 8: Social and Educational Outcomes
The social and educational impact data reveals overwhelmingly positive outcomes across all measured dimensions. Academic performance shows significant improvement with 68.5% of participants reporting positive impacts, while only 5.9% reported negative effects. Community engagement demonstrates the highest positive impact (72.3%), suggesting that digital literacy enhances social participation and community involvement. The strong positive impact on knowledge sharing (75.4%) and professional networks (65.8%) indicates that digital literacy is fostering a more connected and collaborative youth community. The consistently low negative impact percentages (around 5%) across all categories suggest that digital literacy initiatives are generally beneficial with minimal drawbacks.

Outcome Measure	Positive Impact (%)	Neutral (%)	Negative (%)
Academic Performance	68.5	25.6	5.9
Community Engagement	72.3	22.4	5.3
Professional Networks	65.8	28.9	5.3
Knowledge Sharing	75.4	20.1	4.5

These findings indicate significant progress in digital literacy and innovation capacity among youth, while highlighting areas requiring additional intervention and support. The data suggests that targeted programs and infrastructure development have contributed to positive outcomes across multiple dimensions, though considerable challenges remain in ensuring equitable access and sustainable impact.

CONCLUSION

The study reveals crucial insights into digital literacy and youth innovation in Bungoma South Sub-County. The research found that while mobile device access has improved significantly, with 68.5% of youth having smartphone access, substantial gaps exist in advanced digital skills development and infrastructure access. Youth with higher digital literacy levels demonstrated greater engagement in innovative entrepreneurial activities, particularly in sectors like AgriTech and EdTech, which showed sustainability rates of 35.7% and 31.3% respectively. The study also identified critical gaps in advanced computing skills, with only 11.8% of youth achieving intermediate programming proficiency.

RECOMMENDATIONS

Government initiatives should prioritize developing comprehensive digital infrastructure in Bungoma South Sub-County, focusing on reliable internet connectivity in underserved areas. The heavy reliance on mobile data (72.6%) indicates the need for diversified internet access options. Educational policy reforms should mandate digital literacy integration across all education levels, emphasizing practical skills application. Infrastructure development should adopt public-private partnership models, focusing on establishing community technology hubs and expanding 4G coverage beyond the current 42% availability.

REFERENCES

[1] African Development Bank. (2023). Digital skills and entrepreneurship development in Africa: Trends and prospects. African Development Bank Group Publishing.

[2] Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Prentice-Hall.

[3] Communications Authority of Kenya. (2023). ICT access gaps study report 2022/23. Government Printer.

[4] International Telecommunication Union. (2023). Measuring digital development: Facts and figures 2023. ITU Publications.

[5] Kenya Innovation Agency. (2023). State of innovation report: Focus on digital transformation. Government Printer.

[6] Kumar, S., & Singh, M. (2023). Digital literacy programs in developing countries: A comparative analysis. Journal of International Development, 35(4), 589-604.

[7] Martin, A., & Grudziecki, J. (2020). Digital literacy and the digital divide: Contemporary perspectives. Journal of Information Technology Education, 19, 201-220.

[8] Norris, P. (2001). Digital divide: Civic engagement, information poverty, and the Internet worldwide. Cambridge University Press.

[9] Rogers, E. M. (2003). Diffusion of innovations (5th ed.). Free Press.

[10] UNESCO. (2022). Digital literacy global framework. UNESCO Institute for Statistics.

[11] World Bank. (2023). Digital skills report: Bridging the digital divide in developing nations. World Bank Publications.

[12] Yamane, T. (1967). Statistics: An introductory analysis (2nd ed.). Harper and Row.