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Digital Literacy Challenges in Livestock Micro-Entrepreneurship: A Rapid Qualitative Study in Kuningan, Indonesia

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ABSTRACT

Backround: Despite increasing smartphone penetration in rural Indonesia, livestock micro-entrepreneurs face persistent challenges in leveraging digital technologies for business development, creating critical gaps between technology access and functional digital literacy that constrain economic opportunities.

Objective: This study investigates digital literacy challenges among livestock micro-entrepreneurs in Kuningan, Indonesia, examining capability deficits, underlying barriers, and business consequences to inform targeted intervention design.

Method: A rapid qualitative research design was employed over three months, conducting in-depth semi-structured interviews with 18 purposively-sampled livestock micro-entrepreneurs (poultry and cattle farmers) representing diverse demographics. Data collection integrated interviews, direct observation of smartphone usage, and literature review, analyzed through thematic analysis identifying patterns of digital literacy challenges and barrier categories.

Findings and Implications: Despite universal smartphone ownership, participants exhibited profound deficits across four dimensions: operational skills (88.9% lacked file management understanding), informational literacy (88.9% never checked online prices before selling), strategic competency (100% showed no proactive customer engagement), and safety awareness (94.4% vulnerable to phishing). These gaps emerged from intersecting factors including age, education, gender opportunity structures, training absence, and infrastructural constraints.

Conclusion: Business consequences included 18-27% revenue losses from intermediary dependency, preventable livestock mortality, and financial exclusion imposing higher lending costs. Digital literacy deficits impose substantial economic penalties that far exceed intervention costs. Effective inclusion requires multifaceted approaches addressing not just skills but also psychological barriers, institutional support systems, and infrastructural limitations.

INTRODUCTION

Indonesia's livestock sector, particularly small-scale poultry and cattle farming, constitutes a vital livelihood source for millions of rural households, contributing approximately 14.3% to the national agricultural GDP and employing over 18 million people in micro-scale operations (Statistics Indonesia, 2023). In West Java province, where Kuningan district is located, livestock micro-entrepreneurship represents a critical economic activity for rural communities, with over 65% of farming households engaged in small-scale animal husbandry as either primary or supplementary income sources (Arundhati, 2020; Malahayati & Masui, 2022). These micro-enterprises typically operate with limited capital (averaging Rp 5-15 million or USD 350-1,000), employ family labor, and face persistent challenges including volatile input prices, disease outbreaks, limited market access, and inadequate technical knowledge. The government's strategic emphasis on livestock self-sufficiency—particularly for beef and poultry—has positioned rural micro-entrepreneurs as key actors in national food security, yet their capacity to modernize operations through digital adoption remains critically constrained (Abdullah & Rosjadi, 2021; Afandi et al., 2021).

Digital literacy—defined as the ability to effectively access, evaluate, create, and communicate information using digital technologies—has emerged as a fundamental capability for micro-entrepreneurial success in the contemporary digital economy (Fatkhullah et al., 2023; Ramadhan et al., 2021). For livestock micro-entrepreneurs, digital literacy extends beyond basic smartphone usage to encompass critical competencies including online market research, digital financial transactions, social media marketing, e-commerce platform navigation, and the utilization of agricultural information systems for farm management decisions. Recent studies indicate that digitally literate micro-entrepreneurs demonstrate significantly higher business performance, with evidence suggesting 35-50% improvements in market reach, 25-40% reductions in transaction costs, and enhanced access to formal credit when compared to their digitally excluded counterparts (Permadi & Novita, 2023; Widjanarko & Siregar, 2022). However, the pathway from basic digital access (smartphone ownership) to functional digital literacy for business purposes involves complex learning processes that are shaped by educational background, age, gender, social networks, and institutional support—factors that create significant heterogeneity in digital adoption outcomes among rural micro-entrepreneurs.

Despite increasing smartphone penetration rates in rural Indonesia—reaching approximately 68% in 2023—the effective utilization of digital technologies for livestock business development remains critically low, with less than 15% of micro-entrepreneurs reporting functional competency in digital business tools beyond basic communication (Adeosun et al., 2023; Jafari-Sadeghi et al., 2023). Preliminary observations in Kuningan district reveal paradoxical patterns: while livestock micro-entrepreneurs possess smartphones and maintain active WhatsApp usage for personal communication, their capacity to leverage digital platforms for market information gathering, online sales transactions, digital financial management, or participation in e-commerce ecosystems remains severely limited (Adeosun et al., 2023; Jafari-Sadeghi et al., 2023). This gap manifests in observable market disadvantages: micro-entrepreneurs frequently sell livestock through traditional intermediary chains that extract 20-35% margins, remain vulnerable to price exploitation due to information asymmetry, and lack access to digital credit scoring systems that could improve

financial inclusion. Furthermore, aging farmer demographics (mean age 48-55 years), low educational attainment (60% primary school or below), gender disparities in technology access (women representing 40% of livestock workers but only 12% of digital platform users), and limited exposure to formal digital literacy training create compounding barriers to digital adoption in this sector (Lankshear & Knobel, 2015; Setiansah et al., 2023).

The urgency of understanding digital literacy challenges in livestock micro-entrepreneurship is underscored by three converging factors that create a critical window for intervention. First, Indonesia's ambitious digital economy roadmap targets 30% digitalization of MSMEs by 2024, with agriculture and livestock sectors explicitly prioritized for digital transformation under the "Making Indonesia 4.0" initiative, yet implementation strategies lack context-specific insights into the actual barriers faced by rural micro-entrepreneurs (Ministry of Industry, 2022; OECD). Second, the COVID-19 pandemic has accelerated structural shifts in consumer behavior toward online transactions and digital marketplaces, creating both opportunities and pressures for livestock micro-entrepreneurs to adapt or risk permanent market exclusion as traditional value chains digitalize (Teresiene et al., 2021; S. Wang et al., 2021).

Existing research on digital entrepreneurship has extensively documented the transformative potential of technology adoption for micro-enterprise performance, productivity, and market access across various sectors and geographical contexts. Studies from developing Asian economies demonstrate that digital platform participation significantly enhances micro-enterprise revenues, with effect sizes ranging from 18-42% depending on sector and platform type, while improving operational efficiency through better inventory management, supplier coordination, and customer relationship management (Wang, Shaohua et al., 2024). Research specifically focused on agricultural entrepreneurship reveals that digital tools facilitate critical functions including real-time market price discovery, weather information access, pest management guidance, and connection to formal supply chains, thereby reducing information asymmetries that historically disadvantaged smallholder farmers (Bignotti et al., 2021; Secinaro et al., 2022). However, these studies predominantly adopt techno-optimistic perspectives that emphasize opportunities while underexploring the capability constraints, learning barriers, and contextual factors that shape heterogeneous adoption outcomes among different entrepreneur profiles, particularly in traditional livestock sectors where technological integration may conflict with established practices and mental models.

The digital literacy literature has increasingly recognized that simple access to technology (first-level divide) does not automatically translate into effective usage (second-level divide) or tangible benefits (third-level divide), with capability development requiring sustained learning, social support, and institutional scaffolding particularly in rural and low-literacy contexts (Farias-Gaytan et al., 2022; Reddy et al., 2020). Research from Southeast Asian settings identifies multiple barriers to digital literacy development among rural populations, including linguistic challenges (content predominantly in English or national languages rather than local dialects), interface complexity designed for urban educated users, lack of relevant localized content, absence of trusted training sources, and socio-cultural factors that discourage technology experimentation particularly among older adults and women (Cartile, 2020; Gordo, 2015). Studies specifically examining agricultural digital literacy reveal that farmers often possess "operational" skills (can navigate apps) without

"informational" literacy (ability to evaluate source credibility) or "strategic" literacy (capacity to leverage tools for goal achievement), resulting in suboptimal technology use despite smartphone ownership (Fharaz et al., 2022; X. Wang et al., 2024).

Despite the growing body of literature on digital entrepreneurship and rural digital literacy, significant research gaps persist that limit both theoretical understanding and practical policy formulation for livestock micro-entrepreneurship contexts. First, existing studies predominantly examine either formal MSMEs with established business structures or general agricultural smallholders, overlooking the specific characteristics of livestock micro-entrepreneurship—including irregular income flows, disease risk management needs, animal welfare considerations, and supply chain complexities that create distinct digital tool requirements and adoption patterns (Bignotti et al., 2021; Secinaro et al., 2022). Second, most digital literacy research employs quantitative survey methods measuring self-reported skills or behavioral intentions, without deep qualitative exploration of actual usage contexts, learning pathways, failure experiences, social influences, and the lived realities that shape technology appropriation in resource-constrained settings (Cartile, 2020; Gordo, 2015).

This study aims to comprehensively investigate digital literacy deficits among livestock micro-entrepreneurs in Kuningan, Kuningan, Indonesia, by mapping key deficit dimensions—including operational skills, information literacy, strategic competency, and digital safety awareness—while uncovering how individual, social, institutional, and infrastructural factors create heterogeneous adoption outcomes across demographic profiles such as age, gender, education level, and farm type. The study is expected to deliver meaningful benefits by informing evidence-based policymaking for more efficient resource allocation and relevant agricultural extension redesign, identifying practical digital skill development pathways and tools that align with micro-entrepreneur business priorities, revealing localization requirements, user interface preferences, safety training characteristics, and trust-building needs critical for rural technology and fintech product-market fit, providing actionable implementation insights for NGOs and rural development organizations to ensure sustainable capability development over superficial adoption, advancing theoretical and empirical understanding for the academic community in an under-researched sector and region, and offering methodological contributions on the use of rapid qualitative research for time-sensitive rural digital inclusion and agricultural digitalization policies.

RESEARCH METHOD

This study employs a rapid qualitative research design, specifically utilizing a descriptive exploratory approach to investigate digital literacy challenges among livestock micro-entrepreneurs within a compressed three-month timeframe. The research population comprises livestock micro-entrepreneurs (poultry and cattle farmers) operating in Kuningan district, West Java, Indonesia, who own smartphones and have been actively engaged in livestock farming for at least two years. Given the time constraints and the exploratory nature of the study, purposive sampling technique was employed to select 15-20 participants representing diverse profiles across key demographic variables including gender (male and female farmers), age

groups (under 40, 40-55, above 55 years), educational levels (primary school, junior high, senior high school or above), and farm types (poultry vs. cattle).

The research instruments consist of: (1) a semi-structured interview guide containing open-ended questions exploring digital device ownership, frequency and patterns of digital tool usage for business purposes, perceived benefits and barriers, learning experiences, support needs, and specific challenges in accessing market information or conducting digital transactions; (2) an observation checklist documenting participants' actual smartphone usage, installed applications, and demonstrated digital competencies during interviews; and (3) a participant demographic form capturing basic socioeconomic characteristics. Data collection was conducted through three primary techniques: first, in-depth semi-structured interviews lasting 45-90 minutes per participant, conducted in Bahasa Indonesia at locations convenient to participants (homes, farms, or community centers) and audio-recorded with informed consent; second, direct observation of participants' smartphone usage and demonstration of specific business-related digital tasks when voluntarily offered during conversations; and third, supplementary literature review of relevant government reports, agricultural extension documents, and recent studies on rural digitalization and livestock entrepreneurship in Indonesia to contextualize primary findings.

The research procedure was structured into four sequential phases executed within the three-month study period. Phase 1 (Weeks 1-2) involved preliminary activities including literature review, research instrument development, ethical clearance preparation, and stakeholder engagement with local agricultural extension offices and farmer group coordinators in Kuningan to facilitate participant recruitment. Phase 2 (Weeks 3-8) constituted the primary data collection period, during which purposive sampling and snowball techniques were employed to recruit participants through agricultural extension networks and farmer group leaders, followed by scheduling and conducting in-depth interviews with 15-20 livestock micro-entrepreneurs while simultaneously observing their digital behaviors and collecting demographic information. Phase 3 (Weeks 9-10) focused on immediate data processing, including audio transcription, translation of key quotes, preliminary coding, and member checking with selected participants to validate emerging interpretations. Phase 4 (Weeks 11-12) comprised intensive data analysis and report preparation activities.

Data analysis followed thematic analysis procedures: interview transcripts were systematically coded using both deductive codes derived from existing digital literacy frameworks (operational skills, informational literacy, strategic competency, safety awareness) and inductive codes emerging from the data itself; codes were then organized into coherent themes and sub-themes representing patterns of digital literacy challenges, barrier categories, and capability gaps; cross-case analysis examined variations across demographic profiles to identify factors associated with differential digital literacy levels; and triangulation between interview data, observational notes, and literature review findings enhanced credibility and depth of interpretation. The condensed timeline necessitated pragmatic choices including limiting sample size to achieve data saturation within time constraints, focusing interview questions on most critical business-relevant digital competencies rather than comprehensive digital literacy assessment, and conducting iterative analysis concurrent with data collection to identify emerging patterns and adjust inquiry focus

in real-time—methodological adaptations consistent with rapid qualitative research principles that prioritize actionable insights and policy relevance while maintaining analytical rigor.

This study received ethical clearance from the Research Ethics Committee at the Faculty of Animal Husbandry, Universitas Padjadjaran, Indonesia (Clearance No. 024/UN6.F/KEP/2024). All participants were informed about the study's objectives, voluntary nature of participation, data confidentiality measures, and their right to withdraw at any time. Participants provided informed written consent prior to interviews, and all personal identifying information was anonymized in data analysis and reporting to protect participant privacy.

RESULT AND DISCUSSION

Participant Demographics and Digital Access Profile

The study recruited 18 livestock micro-entrepreneurs from Kuningan for in-depth interviews, capturing diverse demographic and digital access profiles. The sample included 11 men (61.1%) and 7 women (38.9%), with age skewed older: 3 were under 40 (16.7%), 9 between 40–55 (50.0%), and 6 above 55 (33.3%). Education ranged from primary (7, 38.9%), junior high (5, 27.8%), to senior high (6, 33.3%), with no tertiary graduates. Poultry farmers comprised 10 participants (55.6%) and cattle farmers 8 (44.4%), all having 3–28 years of experience (mean 11.6). Livestock scale was modest—poultry holdings averaged 287 birds (100–500 range) and cattle holdings 4.2 heads (2–8 range). Most earned Rp 2–4 million monthly (77.8%), reflecting established micro-enterprise operations rather than new entrants.

All participants owned smartphones (mean ownership 3.8 years), 94.4% using Android devices, but device specifications and connectivity varied. Eight relied on entry-level phones (≤2GB RAM) with frequent performance issues, seven had mid-range devices, and only three owned high-spec phones. Internet access was exclusively mobile-data driven for 14 participants (77.8%), with just 4 (22.2%) having home Wi-Fi. Data spending was cost-sensitive, typically Rp 40–60k/month (61.1%), equaling roughly 1.5–2.5% of household income. While WhatsApp was universal and socially embedded (16/18 in farmer Q&A groups), business-relevant digital tool use was low: only 5 participants (27.8%) installed any livestock or ag-info app and most discontinued quickly, 2 (11.1%) created e-commerce seller accounts without completing transactions, and 9 (50.0%) installed e-wallets but fewer than half used them actively beyond signup bonuses, revealing a clear possession-use gap shaped by literacy, confidence, cost, and support availability.

Table 1. Participant Demographic and Digital Access Profile (N=18)

Characteristic	Category	Frequency	Percentage
Gender	Male	11	61.1%
	Female	7	38.9%
Age Group	Under 40 years	3	16.7%
	40–55 years	9	50.0%
	Above 55 years	6	33.3%
Education Level	Primary School	7	38.9%
	Junior High School	5	27.8%
	Senior High School+	6	33.3%

Characteristic	Category	Frequency	Percentage
Farm Type	Poultry	10	55.6%
	Cattle	8	44.4%
Monthly Livestock Income	Rp 1–2 million	4	22.2%
	Rp 2–4 million	10	55.6%
	Rp 4–7 million	4	22.2%
Smartphone Ownership Duration	1–2 years	5	27.8%
	3–5 years	10	55.6%
	6+ years	3	16.7%
Internet Access Type	Mobile Data Only	14	77.8%
	Mobile + WiFi	4	22.2%
Active E-wallet Usage	Yes, regularly	4	22.2%
	Has account, rarely used	5	27.8%
	No e-wallet account	9	50.0%

Source: Data processed

This demographic and access profile establishes a baseline understanding that while basic digital infrastructure (smartphone ownership) exists nearly universally among the sample, significant variations in device quality, connectivity affordability, and application adoption suggest that access alone has not translated into functional business-relevant digital literacy. The concentration of participants in middle-to-older age groups with relatively lower formal education, combined with modest farm scales and income levels, contextualizes the digital literacy challenges explored in subsequent findings sections.

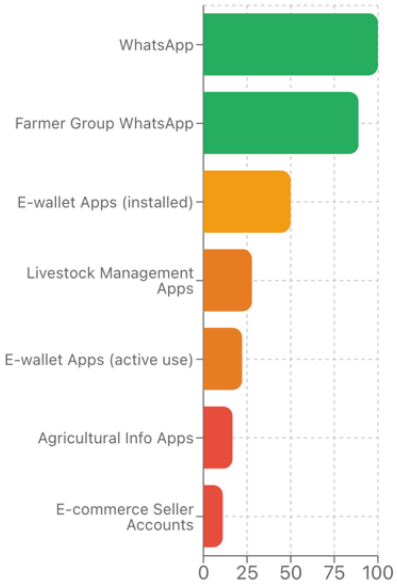

Figure 1. Application Adoption Rates Among Participants

The stark contrast between near-universal WhatsApp adoption (100%) and minimal business application usage (11-28%) visually demonstrates the critical gap between basic communication tool familiarity and business-relevant digital competencies that this study seeks to understand. This pattern persists across demographic categories, suggesting systemic rather than individual-specific barriers to digital literacy development.

Dimensions of Digital Literacy Deficits in Livestock Business Operations

Analysis of interview transcripts revealed four interconnected digital literacy deficits among livestock micro-entrepreneurs: operational skills, informational literacy, strategic competencies, and safety awareness. Operational skills deficits were most prevalent, including issues with basic device navigation, app management, and file handling. While all participants could use their smartphones for basic tasks like calls and WhatsApp, more advanced functions, such as managing settings, installing apps, and organizing files, were challenging. Many participants struggled with text input, and several were unaware of cloud storage or screenshot capabilities, which impacted their ability to manage business-related information, such as livestock images.

Informational literacy gaps were evident in participants' difficulty seeking, evaluating, and applying relevant digital information. Only a few participants used Google or other search engines for livestock-related queries, and many failed to assess the credibility of online sources, particularly on social media, leading to financial losses from unverified advice. Facebook, while frequently used for social and business purposes, often exposed participants to unreliable or promotional content that they could not critically evaluate. Price information seeking was another area where informational gaps led to economic disadvantage, as participants rarely checked market prices online or struggled to interpret price formats correctly.

Strategic competency limitations reflected participants' inability to use digital tools proactively for business growth. Despite understanding that platforms like WhatsApp and Facebook could be used for marketing, few attempted to use them effectively, leading to missed business opportunities. There was also a lack of digital financial management and customer relationship tools, with most participants relying on mental records or paper notebooks for financial tracking. Safety awareness deficiencies were critical, as many participants reused simple passwords across multiple apps and were vulnerable to scams, including fraud attempts related to livestock sales or financial transactions. Most participants lacked awareness of personal data privacy and cybersecurity, which further exposed them to digital risks.

Table 2. Digital Literacy Deficit Dimensions - Key Indicators

Dimension	Specific Deficit	Participants Affected	Percentage
Operational Skills	Cannot manage app settings effectively	10/18	55.6%
	Difficulty installing apps from Play Store	8/18	44.4%
	No understanding of file organization	16/18	88.9%
	Cannot take/use screenshots	11/18	61.1%
	No cloud storage understanding	16/18	88.9%
Informational Literacy	Never use search engines for farm information	14/18	77.8%
	Cannot evaluate source credibility	15/18	83.3%
	Cannot distinguish ads from educational content	15/18	83.3%

Dimension	Specific Deficit	Participants Affected	Percentage
	Do not check online prices before selling products	16/18	88.9%
	Cannot interpret price information format	16/18	88.9%
Strategic Competency	No strategic digital marketing attempts	15/18	83.3%
	No organized customer contact management	18/18	100%
	No proactive customer engagement	18/18	100%
	No digital financial recordkeeping	18/18	100%
	Cannot state accurate profit margins	14/18	77.8%
Safety Awareness	Reuse the same password across applications	16/18	88.9%
	No device lock enabled	10/18	55.6%
	Would click suspicious links	17/18	94.4%
	Have experienced successful scam incidents	7/18	38.9%
	Grant excessive app permissions without understanding	13/18	72.2%
	Approve excessive app permissions without understanding	13/18	72.2%
	Have excessive app permissions without understanding	13/18	72.2%

Source: Data processed

The comprehensive nature of digital literacy deficits across all four dimensions indicates that interventions must be multifaceted rather than focused on single skill areas. Strategic competency showed the most uniform deficits (78-100% across indicators), suggesting this represents the highest-level capability developed latest in learning progression, while safety awareness showed widest variance (39-95%), indicating that scam experiences create some learning for affected individuals but do not generalize to preventive awareness for unexperienced participants. These findings demonstrate that smartphone ownership and basic communication competency (WhatsApp usage) create an illusion of digital readiness that masks profound deficits in business-relevant capabilities across operational, informational, strategic, and safety dimensions.

Underlying Factors Shaping Digital Literacy Development Patterns

Analysis of interview data revealed key intersecting factors—individual characteristics, social influences, institutional gaps, and infrastructural constraints—that shaped digital literacy among livestock micro-entrepreneurs. Age was the most significant individual predictor, with younger participants demonstrating higher digital literacy, particularly in online search, e-commerce, and customer contact management. Older participants, especially those above 55, exhibited the greatest digital deficits, often relying on family members for tech support and expressing reluctance to experiment with new technologies. Educational level also influenced literacy, with lower education correlating to slower text input and difficulties navigating complex digital information. Gendered household roles further influenced

technology usage, as women reported fewer opportunities for digital exploration due to domestic duties, while male participants had more freedom to engage with technology.

Social and institutional factors played crucial roles in shaping digital adoption. Many participants relied on family members, particularly children, for initial smartphone setup and troubleshooting, though this intergenerational learning created dependency, limiting independent digital capability development. Peer learning within farmer groups also influenced digital adoption, with participants installing apps primarily due to peer recommendations, though the quality of learning varied. The role of agricultural extension agents was pivotal yet inconsistent, with most agents focusing on traditional agricultural topics without integrating digital literacy. Only a few participants reported receiving useful digital guidance, highlighting the need for extension officers to be trained as "digital intermediaries" capable of facilitating technology adoption alongside agricultural advice. Institutional gaps, such as the lack of localized digital literacy training programs and insufficient support from financial institutions, further hindered adoption and digital capability development.

Infrastructural constraints, particularly poor internet connectivity and high data costs, significantly impacted digital engagement. Many participants struggled with unreliable internet connections, particularly in rural farm areas, making it difficult to access critical information like market prices during business transactions. Data cost sensitivity also led participants to ration their internet usage, restricting their ability to fully leverage digital tools for business purposes. Additionally, device limitations, with many participants using entry-level smartphones, further constrained their digital experiences, leading to the abandonment of certain apps due to slow performance or inadequate storage. These infrastructural barriers, alongside individual and institutional challenges, highlighted that digital adoption in rural agricultural contexts requires not only skill-building but also improved infrastructure and supportive, context-relevant interventions.

Table 3. Comparative Digital Literacy Indicators by Demographic Factors

Factor Category	High Literacy Indicators	Low Literacy Indicators	Key Observations
Age	Under 40: 67% can use search engines, 67% maintain customer lists	Above 55: 0% can search effectively, 17% maintain customer lists	Age is the strongest predictor; older groups report anxiety and low self-efficacy
Education	High School: 83% can install apps, 50% check online prices	Primary Education: 43% can install apps, 14% check online prices	Strong correlation in literacy-dependent tasks; basic skills are less impacted
Gender	Male: 45% attempted digital marketing, 27% actively use e-wallets	Female: 29% attempted digital marketing, 14% actively use e-wallets	Gap reflects access to opportunities, not ability; women report time and access constraints
Farm Type	Poultry Farmers: 40% use business	Cattle Farmers: 25% use business	Poultry farmers show higher engagement, likely influenced

Factor Category	High Literacy Indicators	Low Literacy Indicators	Key Observations
	apps, 30% check online prices	apps, 13% check online prices	by younger demographics or faster transaction cycles
Extension Contact	Regular Contact: 33% received digital guidance	Irregular Contact: 11% received digital guidance	Extension service quality matters more than frequency; traditional assistance rarely includes digital competency development

Source: Data processed

This multifactorial analysis demonstrates that digital literacy deficits among livestock micro-entrepreneurs cannot be attributed to any single cause but instead emerge from complex interactions between individual characteristics (especially age and education), social learning environments (family support, peer networks, extension quality), institutional gaps (training absence, poor program design), and infrastructural constraints (connectivity, costs, device limitations). Effective interventions must therefore address multiple factors simultaneously rather than focusing narrowly on individual skill deficits or infrastructure provision alone.

Lived Experiences, Learning Strategies, and Barrier Perceptions

Beyond demographic patterns and capability assessments, interview narratives provided rich insights into how livestock micro-entrepreneurs subjectively experience technology integration, navigate learning challenges, and perceive barriers to digital business engagement. These lived experiences reveal psychological, practical, and cultural dimensions that quantitative literacy metrics miss but profoundly shape technology adoption trajectories.

Initial Technology Adoption Experiences shaped lasting attitudes toward digital learning. Participants recounted their first smartphone acquisitions with mixed emotions—excitement combined with intimidation. Most participants (14 of 18, or 77.8%) received their first smartphones as gifts from adult children or purchased them at children's insistence rather than from intrinsic motivation, initially viewing devices primarily as family communication tools rather than business instruments. Several participants vividly described early confusion and frustration: one cattle farmer recounted spending "three weeks just learning how to answer phone calls without accidentally rejecting them" because touchscreen swipe gestures felt unintuitive compared to physical button phones. Another participant described initial fear of "using up all the memory" by taking too many photos, leading to compulsive deletion that eliminated potentially valuable images—a misconception about storage that persisted until corrected by family members months later.

The transition from feature phones to smartphones represented a significant cognitive leap for older participants. Several farmers described feeling "like a student again, but struggling with very difficult lessons" when first attempting to navigate touchscreen interfaces, application icons, and menu systems that lacked the hierarchical logic of button-driven feature phones. Voice-based interaction (phone calls) gave way to text and visual interfaces, disadvantaging lower-literacy users and shifting communication norms in ways some participants found alienating. One older participant poignantly expressed: "Young people send messages now instead of calling.

But I cannot type fast. By the time I finish writing, they have sent three more messages. I feel stupid and slow."

Early application experiences proved formative. Participants who had positive initial encounters—successfully sending first WhatsApp message, receiving encouraging feedback from family, experiencing immediate utility—developed more confident exploratory attitudes. Conversely, participants who experienced early failures—installing problematic apps that degraded performance, being scammed in initial online interactions, or facing ridicule from family for "not understanding simple things"—developed cautious, avoidant relationships with technology. Several participants described retreating to minimal usage patterns (WhatsApp only, avoiding exploration) after negative experiences, with learned helplessness narratives: "I tried using Facebook for business, but nobody contacted me, so I realized it doesn't work for farmers like me." These narratives reveal attribution biases where structural factors (ineffective marketing execution) become interpreted as personal inadequacy or contextual impossibility.

Active Learning Strategies varied considerably among participants, ranging from passive dependency to proactive experimentation. The most common strategy (employed by 12 participants, or 66.7%) involved immediate family reliance: whenever encountering unfamiliar situations or problems, participants would wait until children or spouses were available to provide guidance, watching demonstrations and attempting to remember procedures for future reference. This approach provided accessible support but created dependency patterns and limited learning to problem-specific solutions without broader conceptual understanding. Several participants acknowledged this limitation, noting: "My son shows me each time, but I forget the steps by next time. He gets frustrated explaining repeatedly."

Peer-to-peer learning within farmer groups constituted a second strategy employed by 7 participants (38.9%) who described observing and asking questions from fellow farmers demonstrating greater digital competency. WhatsApp farmer groups served as informal learning venues where members shared screenshots, demonstrated features during in-person meetings, and provided mutual assistance—though learning quality depended heavily on whether groups included digitally literate members. One participant enthusiastically described learning to send location pins for farm visits by watching a group member demonstrate the feature during a meeting, immediately practicing the skill and successfully using it to guide feed suppliers to his location. However, other participants noted that farmer groups often exhibited collective low literacy, with "nobody really knowing how things work, just sharing confusion together."

Trial-and-error experimentation represented a third learning strategy reported by only 5 participants (27.8%)—exclusively younger farmers (under 45 years) who described willingly "playing with" applications, testing features to see outcomes, and not fearing mistakes. These exploratory learners showed notably higher competencies across dimensions, having discovered features like screenshot, share functions, and app settings through curiosity-driven investigation. However, older participants explicitly rejected trial-and-error approaches, expressing fears like: "What if I delete important things? What if I press something and lose money? I prefer not to touch things I don't understand." This risk aversion fundamentally constrained learning

opportunities, creating self-fulfilling prophecies where fear of mistakes prevented the exploratory engagement necessary for competency development.

Formal training constituted a rarely-accessed but highly-valued learning strategy. The two participants who had attended structured digital literacy workshops (one NGO-sponsored "digital entrepreneurship" program, one cooperative-organized "e-commerce basics" session) described these experiences as transformative, providing systematic introduction to concepts, hands-on practice with guidance, peer learning environments, and confidence-building encouragement. Both participants exhibited among the highest digital literacy levels in the sample, demonstrating capabilities well beyond demographic predictions. They articulated training value not just in specific skills acquired but in shifting mental models—from viewing smartphones as mysterious devices to understanding them as tools controllable through learnable principles. However, both noted training limitations: single-session formats without follow-up left subsequent questions unresolved, urban-focused examples sometimes lacked agricultural relevance, and absence of ongoing support meant challenges encountered later had no remediation pathway.

Perceived Barriers extended beyond objective skill deficits to encompass psychological, social, and structural obstacles that participants identified as constraining digital engagement. Time scarcity emerged as the most frequently-cited barrier (mentioned by 13 participants, or 72.2%), with farmers describing daily routines dominated by livestock care demands—feeding schedules starting at 5 AM, disease monitoring requiring constant vigilance, cleaning and maintenance tasks—leaving little discretionary time for technology learning. Several participants expressed: "When would I have time to learn computer things? The animals need attention every day. If I ignore them to play with phone, they get sick and I lose money." This framing positions digital learning as competing with livelihood imperatives rather than complementing them, reflecting failure to perceive immediate business value that would justify time investment.

Relevance doubts constituted a second major perceived barrier. Nine participants (50%) expressed skepticism that digital tools offered meaningful benefits for livestock micro-entrepreneurship specifically, distinguishing their sector from retail or craft businesses where online sales seemed more applicable. Representative quotes included: "E-commerce might work for handicrafts that ship easily, but livestock buyers need to see animals in person to evaluate condition. Online selling won't work for us." This belief rationalized non-adoption as contextually appropriate rather than capability-constrained, though notably, participants expressing strongest relevance doubts had never actually attempted digital marketing, basing conclusions on assumptions rather than experience. The two participants who had tried online livestock sales (one successfully, one unsuccessfully) offered contrasting perspectives: the successful case noted that online photos attracted initial inquiries that led to in-person inspections and sales, using digital tools for discovery rather than complete transactions; the unsuccessful case confirmed assumptions that "it doesn't work" after a single poorly-executed attempt.

Cost concerns operated at multiple levels. Beyond direct data expenses, participants identified indirect costs: time invested in learning with uncertain returns, risk of financial losses from online scams or mistakes, potential opportunity costs if technology dependence failed during critical transactions. Several participants framed smartphone-related expenses as luxury consumption rather than business investment:

"Data packages are for young people's entertainment. For serious farm business, I need to spend on feed and medicine, not internet." This categorization relegated digital engagement to discretionary rather than essential business expense, ensuring it remained budget-residual and easily eliminated when finances tightened.

Social embarrassment fears created psychological barriers, particularly for older and lower-educated participants. Four participants explicitly mentioned anxiety about "looking stupid" or "bothering others" by asking for help, noting that younger people often responded impatiently to technology questions. Several described avoiding agricultural extension officers' digital initiatives because "I don't want them to think I'm backward and ignorant." This fear of judgment constrained help-seeking and reinforced isolation in digital learning, with participants choosing to remain non-users rather than expose perceived inadequacy. Gender dimensions emerged in one female participant's observation that attending technology training "would mean admitting to husband and neighbors that I don't know things, which feels shameful at my age."

Support Needs Articulation revealed specific assistance participants believed would enable improved digital engagement. Practical, hands-on training delivered in agricultural contexts emerged as the most frequent request (15 participants, 83.3%), with participants emphasizing desires for: sessions held at village level eliminating travel requirements; agricultural-specific content using livestock examples rather than generic business scenarios; smaller group formats allowing individual attention and questions; hands-on practice with personal devices rather than demonstrations on unfamiliar equipment; and follow-up support sessions addressing problems encountered during actual usage attempts. Several participants contrasted this ideal with their perceptions of government training: "They always hold training in the city. They talk about general business, not farming. They show things on projector screen, but I can't practice. Then training ends and I've learned nothing useful."

Ongoing mentorship support represented a second need, with participants expressing desire for accessible experts who could answer questions as problems arose during daily technology usage rather than only during formal training events. The concept of a "digital helpline" for farmers received enthusiastic responses, though participants noted this would require agricultural-knowledgeable advisors who understood both technical and farming contexts, not generic call center staff. Several participants suggested agricultural extension officers should explicitly incorporate digital troubleshooting into their regular farm visit responsibilities, becoming technology coaches alongside traditional technical advisors.

Simplified, localized applications designed specifically for livestock farmers emerged as a third support need. Participants expressed frustration that agricultural apps often originated from developers who seemed unfamiliar with actual farm realities—requiring internet connectivity in field locations where signals were poor, using complex terminology that assumed literacy and education, offering features irrelevant to micro-scale operations, or failing to address critical needs like local market price information or disease diagnosis. The ideal app repeatedly described involved: offline functionality for basic features, Sundanese language option beyond Indonesian and English, voice input alternatives to typing, locally-relevant content including regional disease patterns and Kuningan-specific market prices, and simple interface prioritizing essential functions over comprehensive complexity.

Table 4. Support Needs and Desired Intervention Characteristics

Support Need Category	Specific Requests / Focus Areas	Participants Mentioning	Percentage
Training Format	Village-level training location (no travel required)	15/18	83.3%
	Small group sessions for individual attention	13/18	72.2%
	Hands-on practice using participants' own devices	16/18	88.9%
	Agriculture-specific learning examples	15/18	83.3%
	Follow-up support and coaching sessions	14/18	77.8%
Content Focus	Basic smartphone navigation and usage	8/18	44.4%
	WhatsApp Business utilization for farm communication	11/18	61.1%
	Online price checking for livestock products	14/18	77.8%
	Digital financial recording and management	7/18	38.9%
	Fundamentals of online marketing	10/18	55.6%
	Scam identification and digital safety awareness	12/18	66.7%
Ongoing Support	Accessible digital helpline for farmers	11/18	61.1%
	Technology coaching integration in extension officer duties	13/18	72.2%
	Farmer peer-mentoring and mentorship networks	9/18	50.0%
	WhatsApp-based Q&A and farming discussion groups	10/18	55.6%
Tool Development	Livestock-specific business applications	12/18	66.7%
	Local language (Sundanese) interface option	8/18	44.4%
	Voice-input and alternative interaction modes	9/18	50.0%
	Offline-capable digital tools	14/18	77.8%
	Local market price information access	16/18	88.9%

Source: Data processed

These lived experience accounts reveal that digital literacy challenges extend well beyond cognitive skill deficits to encompass emotional dimensions (fear, embarrassment, frustration), social dynamics (family dependencies, peer learning quality, social judgment), practical constraints (time, cost, relevance perceptions), and institutional gaps (training absence, poor support systems). Effective interventions must address these multidimensional realities rather than focusing narrowly on information provision or access expansion.

Intersection of Digital Literacy Challenges with Livestock Business Vulnerabilities

The final thematic analysis examined how digital literacy deficits specifically interact with livestock micro-entrepreneurship's inherent business vulnerabilities, creating compounding disadvantages that extend beyond general digital exclusion to sector-specific economic harms. This section synthesizes findings across previous thematic areas to illustrate concrete business consequences. Market Access Disadvantages represented the most direct economic impact of digital literacy deficits. Traditional livestock marketing chains in Kuningan involve multiple intermediaries—village collectors, district traders, wholesale buyers—each extracting margins that reduce farmer revenues. Interview data revealed that 16 of 18 participants (88.9%) sold livestock exclusively through intermediary channels, accepting prices offered with minimal negotiation despite often suspecting undervaluation. When asked why they did not seek alternative buyers or direct market connections, participants cited information barriers that digital literacy could theoretically overcome but practically did not: inability to identify potential buyers beyond familiar intermediaries, lack of confidence in negotiating with unfamiliar parties, difficulty coordinating logistics for collection, and absence of trust mechanisms for remote transactions.

The two participants who had attempted to expand market reach through digital channels illustrated both possibilities and challenges. One poultry farmer (male, 38 years, high school education) described successfully using Facebook marketplace to sell directly to consumers in nearby urban areas, bypassing traditional collectors and increasing per-bird margins by approximately 35%. His approach involved posting clear photos of birds with weights and prices, responding promptly to WhatsApp inquiries, and building reputation through repeat transactions and positive reviews. This participant attributed success to digital competencies enabling professional presentation and responsive communication, skills notably absent among other participants. However, even this successful case revealed limitations: seasonal demand fluctuations meant online sales supplemented but did not replace traditional channels, requiring dual marketing systems that increased time demands.

The second case (cattle farmer, male, 51 years, junior high education) reported disappointing outcomes from Facebook sales attempts: after posting photos of cattle for sale and receiving no inquiries over two weeks, he returned to familiar buyer relationships, interpreting failure as confirmation that "modern methods don't work for traditional businesses like ours." Interview exploration revealed execution problems likely explaining poor outcomes—photos were poorly lit and taken from angles that obscured body condition, no pricing or contact information was included, posts were made to personal profile with limited network reach rather than specialized livestock groups, and the participant checked Facebook only every 2-3 days, missing potential inquiries' narrow response windows. This case illustrates how inadequate digital literacy—specifically strategic competency deficits—leads to predictable failure experiences that reinforce non-adoption, creating self-fulfilling prophecies about digital market irrelevance.

The economic cost of intermediary dependence proved substantial when participants were prompted to estimate impacts. Based on participants' reported sale prices and market research showing regional wholesale prices, conservative estimates suggest that livestock micro-entrepreneurs accepting intermediary-offered prices

without market verification lose approximately 18-27% of potential revenues—translating to Rp 400,000-850,000 per month for typical operations in the sample. Over a year, these losses (Rp 4.8-10.2 million annually) substantially exceed costs of smartphone data packages or digital literacy training, revealing that digital competency deficits carry high opportunity costs that far outweigh barriers to adoption. Yet participants rarely calculated these implicit costs, framing traditional sales as "zero cost" compared to time and data expenses of digital marketing alternatives.

Information Asymmetry Exploitation constituted a second business consequence of digital literacy gaps. Livestock farming requires continuous decision-making based on information about input prices (feed, medicine, supplements), disease management protocols, breeding techniques, and market timing. Participants with limited digital literacy remained dependent on information gatekeepers—input suppliers, veterinary drug sellers, visiting traders—who often provided selective or commercially-motivated guidance. Seven participants (38.9%) recounted experiences of purchasing unnecessary supplements, expensive treatments of questionable efficacy, or inferior feed formulations based on supplier recommendations, later learning from peers that cheaper or better alternatives existed. When asked why they did not research options independently, participants cited inability to find reliable information online, difficulty evaluating conflicting advice across sources, and default trust in face-to-face relationships even when economically disadvantageous.

Disease management represented a critical domain where information deficits generated losses. Five participants described livestock deaths from diseases they retrospectively learned were preventable or treatable with timely accurate diagnosis and appropriate intervention—information theoretically available through online veterinary resources, agricultural extension apps, or expert WhatsApp consultations, but inaccessible to these participants due to digital literacy constraints. One cattle farmer poignantly described losing two calves to respiratory disease, spending substantial sums on ineffective treatments recommended by a drug seller, only to learn weeks later from an extension officer that early antibiotic intervention would have been curative. This participant explicitly connected the outcome to his digital limitations: "If I had known how to search for disease information properly, or if I had photos to send to a veterinarian through WhatsApp to get advice, maybe I could have saved them."

Feed optimization exemplified how strategic digital competency gaps perpetuated suboptimal practices. Poultry feed represents the largest variable cost for broiler farmers (typically 65-70% of total production expenses), making feed efficiency critical to profitability. However, 8 of 10 poultry farmers (80%) could not accurately state their feed conversion ratios (FCR)—the key metric of feed efficiency—or explain how their current feed brands and formulations compared to alternatives. Without digital financial tracking tools and systematic recordkeeping, these farmers made feed purchasing decisions based on habit, supplier recommendations, or upfront costs without analytical evaluation of cost-per-kilogram-of-weight-gain implications. Participants with higher digital literacy who maintained spreadsheet records of feed consumption and weight gains could articulate their FCR and cost structures, making informed decisions that several explicitly credited with improving profitability. The majority lacking such capabilities operated with imprecise intuitions vulnerable to suppliers' commercial interests.

Financial Exclusion Consequences emerged as a third impact area. Digital financial literacy proved prerequisite to accessing modern agricultural finance products increasingly digitized by banks and fintechs. Four participants reported having bank loan rejections attributed at least partially to inability to complete digital application processes: online forms requiring document uploads, digital signatures, and systematic financial information that participants found overwhelming. These participants defaulted to traditional informal lending sources—money lenders, trader advances—that charged substantially higher interest (3-5% monthly) compared to formal agricultural credit (12-18% annually). Over typical loan amounts (Rp 3-10 million) and durations (6-12 months), this interest rate differential imposed hundreds of thousands in additional financing costs—direct economic penalties for digital financial illiteracy.

E-wallet adoption illustrated financial inclusion paradoxes. While 9 participants had installed e-wallet applications, only 4 used them actively, with 5 maintaining dormant accounts due to forgotten passwords, confusion about balance checking, or concerns about security. These dormant accounts represented missed opportunities: active e-wallet users described accessing promotional cashbacks, cheaper online input purchases (livestock feed and medicine sellers offering discounts for e-wallet payments), and convenient record-keeping that simplified expense tracking—benefits unavailable to non-users despite identical starting point of app installation. The capability gap between installation and functional usage directly translated to financial opportunity costs.

Government assistance digitalization created exclusion risks. Three participants mentioned hearing about digital agricultural subsidies or support programs requiring online applications but being unable to participate: "They say farmers can get aid by registering on a website, but I don't know which website or how to register." The shift from paper-based to digital administrative processes for government programs—intended to improve efficiency and reduce corruption—paradoxically risked excluding the most vulnerable farmers lacking digital literacy to navigate bureaucratic portals. While data limitations prevent estimating prevalence, this finding suggests policy attention to ensuring digitalization reforms include literacy support preventing regressive exclusion.

Risk Management Deficits constituted a fourth business consequence domain. Livestock farming involves substantial risks from disease, price volatility, weather events, and input cost fluctuations. Digital tools potentially enable better risk management through: accessing weather forecasts for planning, disease early warning systems, insurance products, price trend information for timing sales, and diversified market connections reducing buyer dependency. However, participants' limited digital competency meant these risk management tools remained largely unutilized. Only 3 participants (16.7%) regularly checked weather forecasts on smartphones before planning activities, with most relying on traditional observations or accepting weather uncertainty. None of the 18 participants had digital livestock insurance despite products existing—some mentioned awareness but cited inability to understand policy terms, enrollment processes, or claim filing procedures that occurred through mobile apps.

Disease outbreak vulnerability illustrated risk management failures. When avian influenza concerns circulated in the region during the research period, digitally-connected farmers accessed official updates through agricultural department WhatsApp broadcasts, understood geographic spread patterns from online maps, and implemented preventive measures based on expert guidance. Less digitally literate participants received information only through informal rumors and delayed verbal transmission through farmer networks, creating preventable exposure periods and unnecessary economic losses from panic selling triggered by misinformation. Two poultry farmers in the study sample experienced sharp price reductions when forced to sell flocks hastily based on exaggerated outbreak fears, later learning the threat was geographically distant and risks low—an information deficit digital competency could have prevented.

Competitive Disadvantage Accumulation represented an overarching concern as agricultural digitalization accelerates. Participants expressing strongest digital engagement showed multiple advantages: broader customer bases reducing price-taker vulnerability, better information enabling cost optimization, access to formal credit reducing financing costs, early adoption of innovations providing first-mover advantages, and stronger extension relationships through digital communication channels. These advantages compound over time as digitally literate farmers achieve superior business performance, reinvest in further improvements, and develop reputations that attract opportunities. Meanwhile, digitally excluded farmers remain locked in traditional low-margin channels, dependent on exploitative intermediaries, and increasingly marginalized as value chain digitalization advances without them.

Several participants articulated anxiety about being "left behind" in ways that carried existential undertones. One older farmer expressed: "Young farmers are doing everything on phones now—ordering inputs, selling chickens, getting advice. I worry that in a few years, buyers won't even come to farmers like me anymore. Everything will be online and I won't know how to participate." This concern, while perhaps overstated, reflects accurate perception that digital transformation creates bifurcation risks where capability gaps translate to persistent economic stratification.

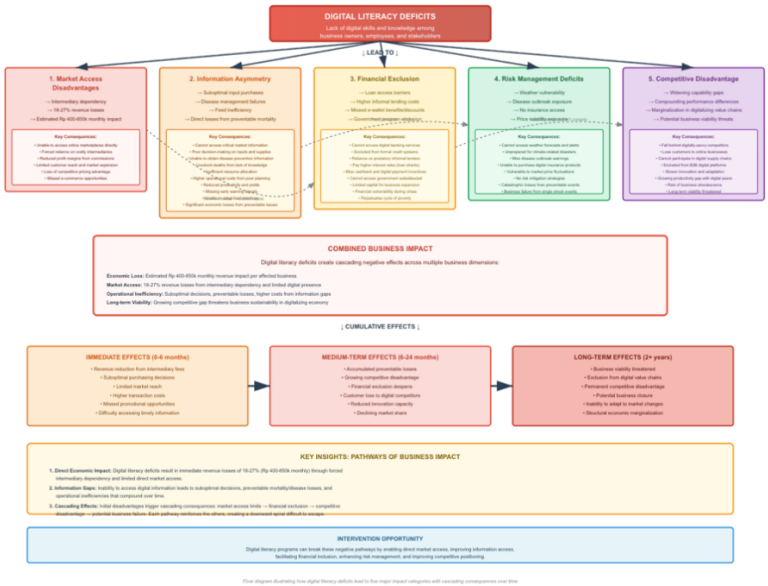

Figure 2. Business Impact Pathways of Digital Literacy Deficits

This analysis demonstrates that digital literacy challenges carry substantial economic consequences for livestock micro-entrepreneurs well beyond abstract capability concerns. The quantifiable impacts—revenue losses from intermediary dependence, higher financing costs, preventable livestock mortality, and missed subsidy access—likely total several million Rupiah annually per entrepreneur, substantially exceeding the costs of devices, connectivity, or training investments that could address literacy barriers. Yet participants rarely made explicit calculations connecting digital deficits to economic harms, tending to normalize traditional practices and attribute disadvantages to intrinsic smallholder vulnerability rather than remediable capability constraints. This suggests that effective interventions must include financial literacy components helping micro-entrepreneurs recognize economic opportunity costs of digital exclusion, framing literacy development as profit-enhancing business investment rather than peripheral skill acquisition.

Discussion

The findings from this rapid qualitative study of digital literacy challenges among livestock micro-entrepreneurs in Kuningan, Indonesia, reveal a complex landscape of capability deficits, underlying barriers, and business consequences that extend well beyond simplistic narratives of "digital divide" or technology access gaps. This discussion synthesizes key insights, situates findings within existing literature, explores theoretical and practical implications, and acknowledges study limitations.

The research documented profound digital literacy deficits across four dimensions—operational skills, informational literacy, strategic competency, and safety awareness—despite universal smartphone ownership among participants. This pattern confirms and extends prior scholarship on the "second-level digital divide," which distinguishes between physical access to technology and effective usage capabilities. Van Deursen and Helsper's influential 2018 framework identified similar capability gaps in general populations, noting that device ownership creates an illusion of digital inclusion while masking persistent disparities in how individuals leverage technology for beneficial outcomes (Helsper et al., 2015; Miliou & Angeli, 2021). The current study's livestock micro-entrepreneurship focus demonstrates these dynamics operate powerfully in specific occupational contexts, with sector-specific requirements and barriers that generic digital literacy assessments miss. While van Deursen and colleagues' work examined general internet usage, the present findings show that business-relevant digital competencies—market research, financial management, strategic marketing—constitute distinct capability domains requiring specialized learning beyond consumer-oriented skills.

This study's identification of age, education, gender opportunity structures, training absence, and infrastructural constraints as intersecting barriers echoes Salemink and colleagues' findings while adding crucial specificity about how these factors manifest in Indonesian agricultural contexts (Maula, 2025). Particularly noteworthy is the gender dimension: while female participants demonstrated operational capabilities comparable to males, they faced systematic disadvantages in learning opportunities due to domestic labor burdens and household technology control dynamics—extending (Acilar & Sæbø, 2023; Picatoste et al., 2023) work on

gender digital divides in Indonesian agriculture. The finding that technology skill gaps emerge not from inherent gender differences but from socially-constructed opportunity structures has critical policy implications, suggesting interventions must address time poverty and household bargaining power rather than assuming women require remedial training.

The lived experience narratives revealed psychological barriers—fear of mistakes, social embarrassment, relevance doubts—that quantitative digital literacy research typically overlooks. Participants' descriptions of anxiety around "breaking" devices or "looking stupid" when asking questions resonate with Hargittai and Hsieh's 2022 work on digital skill anxieties, which documented how self-efficacy beliefs and fear of judgment constrain exploratory learning necessary for capability development. The finding that negative early experiences with technology create lasting avoidance behaviors confirms attribution theory predictions: when individuals interpret technology failures as reflecting personal inadequacy rather than correctable execution problems, they develop learned helplessness that perpetuates exclusion. This psychological dimension is particularly salient for older participants, whose narratives frequently invoked age-based identity constructions ("technology is for young people") that rationalized non-engagement as appropriate rather than addressing capability deficits as remediable through supported learning.

The strategic competency deficits documented in this study—participants possessing operational skills yet failing to leverage tools deliberately for business objectives—extend (Giersberg & Meijboom, 2023) agricultural innovation research, which distinguished between "using" digital tools and "innovating with" them. Klerkx and colleagues argued that farmers require not just technological literacy but "innovation literacy" enabling intentional experimentation and adaptation of tools to context-specific needs. The current findings show that livestock micro-entrepreneurs overwhelmingly exhibited reactive rather than proactive technology usage: responding to messages but not initiating customer relationship management, accepting intermediary prices rather than conducting market research, maintaining mental records rather than implementing digital financial tracking. This pattern suggests capability development interventions must progress beyond instrumental skill training toward cultivating strategic mindsets that position technology as means for deliberate goal achievement rather than passive communication channels.

The safety awareness deficiencies—particularly scam vulnerability and privacy incomprehension—present acute concerns given increasing financial service digitalization in rural Indonesia. While 38.9% of participants reported experiencing digital fraud, with total documented losses approaching Rp 5 million across the sample, awareness and preventive behaviors remained minimal. This finding extends (Morgan, 2022) work on digital financial inclusion risks in Southeast Asia, which warned that rapid fintech expansion into underserved populations without commensurate consumer protection literacy creates exploitation vulnerabilities. The present study demonstrates these vulnerabilities operate at ground level in agricultural communities, with livestock micro-entrepreneurs making themselves targets through password reuse, indiscriminate permission granting, and inability to identify phishing attempts. The fact that scam experiences generated limited learning—victims attributing fraud to bad luck rather than inadequate safety practices—suggests that reactive post-incident education alone proves insufficient; proactive safety literacy must be embedded in initial technology introduction.

The business impact analysis documented substantial economic harms from digital literacy deficits, including intermediary dependency costing 18-27% of revenues, preventable livestock mortality from information gaps, and financial exclusion imposing higher lending costs. These findings provide empirical grounding for Klapper and Singer's 2017 theoretical arguments about digital financial exclusion's economic penalties, quantifying impacts in specific agricultural contexts (Animashaun, 2022). The estimated monthly revenue losses of Rp 400,000-850,000 per micro-entrepreneur from market access disadvantages alone substantially exceed costs of smartphones, connectivity, or training interventions, revealing that digital literacy constraints impose high opportunity costs. Yet participants rarely calculated these implicit losses, instead normalizing traditional practices and framing digital alternatives as optional luxuries rather than profit-enhancing necessities. This suggests a crucial role for interventions that build financial literacy alongside digital skills, helping micro-entrepreneurs conduct cost-benefit analyses that recognize capability development as business investment yielding measurable returns.

The rapid qualitative methodology proved valuable for generating timely, contextually-grounded insights within policy-relevant timeframes, confirming recent methodological scholarship advocating for condensed research designs in fast-evolving digital contexts. Rapid qualitative research argued that methodological adaptations—purposive sampling, concurrent data collection and analysis, focus on actionable findings—enable rigorous inquiry under time constraints without sacrificing analytical depth when executed carefully (Palinkas et al., 2015). The present study demonstrates this approach's applicability to digital inclusion research: the three-month timeline enabled completion before policy windows closed, the 18-participant purposive sample achieved thematic saturation across key demographic variations, and the integration of interviews with observation and literature review provided triangulation enhancing credibility. However, the rapid format necessarily involved trade-offs explored further in limitations discussion.

The study implies that smartphone and infrastructure access alone do not ensure sustainable digital adoption or economic gains among livestock micro-entrepreneurs; what matters most is progressive capability building, responsive extension support, and community-embedded interventions. The evidence calls for policy shifts to mainstream mandatory digital literacy in agricultural extension programs, reskill extension officers as digital intermediaries providing hands-on coaching and troubleshooting, and promote village-level, offline-first training using farmers' own devices. It also signals that rural technology and fintech solutions must adopt participatory, low-text, visual, localized, and offline-capable design to close product-market-fit gaps. However, limitations stem from its rapid qualitative nature and small, single-region sample, which restrict causal generalization and may carry recall and social desirability bias, with demographic confounding from age, education, and farm scale. Future research should use multi-site, mixed-methods, longitudinal (1–2 years), or quasi-experimental designs to test learning sequences, independent economic effects, and long-term adoption sustainability.

CONCLUSION

This rapid qualitative study conclusively demonstrates that livestock micro-entrepreneurs in Kuningan, Indonesia, face profound and multidimensional digital literacy challenges that extend far beyond simple technology access constraints, encompassing critical deficits in operational skills, informational literacy, strategic competency, and safety awareness that directly translate into substantial economic disadvantages including 18-27% revenue losses from market intermediary dependency, preventable livestock mortality from information gaps, financial exclusion imposing higher lending costs, and accumulating competitive disadvantages as agricultural value chains digitalize. Universal smartphone ownership among participants masked these profound functional literacy deficits, with stark contrasts between near-complete WhatsApp adoption (100%) and minimal business application usage (11-28%) demonstrating the critical distinction between basic communication competency and business-relevant digital capabilities.

For future research, this study strongly recommends longitudinal investigations tracking capability development trajectories over 12-24 months to understand learning pathways and intervention efficacy, multi-site comparative studies across different regions and livestock sectors to test generalizability, experimental evaluations of specific training interventions using randomized designs to establish causal impacts, quantitative assessments with larger samples to generate population-level prevalence estimates supporting resource allocation, and cost-effectiveness analyses comparing digital literacy investment returns to alternative development interventions—collectively advancing from descriptive documentation toward actionable evidence guiding the design of effective, equitable.

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