

# Ecosystems of Empowerment: Integrating Artificial Intelligence with Community-Based Support for Women-Led Micro-Enterprises – Evidence from Bengaluru, Karnataka

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## ABSTRACT

In the bustling heart of India's Silicon Valley, Bengaluru, a quiet revolution is underway, not in its gleaming tech parks, but in the homes and neighborhood corners where women run micro-enterprises. This study investigates how Artificial Intelligence (AI), when thoughtfully integrated with community-based support systems, enhances the operational capacity, confidence, and growth of these women-led businesses. Through a mixed-methods study of 200 women entrepreneurs affiliated with three local women's NGOs, the research explores the adoption patterns, challenges, and benefits of accessible AI tools—such as digital bookkeeping apps, WhatsApp automation, and social media helpers—within the context of grassroots mentorship and peer networks. Our findings indicate that while AI tools alone are underutilized and often intimidating, their combination with structured NGO-led training, emotional support, and practical guidance significantly improves business outcomes. The study concludes that true technological empowerment arises not from tools alone, but from socio-technical ecosystems of care, learning, and local relevance. We argue that empowerment is a collective process, strengthened by both smart tools and warm support, and call for human-centered AI adoption strategies rooted in community trust and grassroots innovation.

This study investigates how Artificial Intelligence (AI), when thoughtfully integrated with community-based support systems, enhances the operational capacity, confidence, and growth of women-led micro-enterprises in Bengaluru, Karnataka. Through a sample of 200 women entrepreneurs affiliated with three local women's NGOs, the research explores the adoption patterns, challenges, and benefits of accessible AI tools—such as digital bookkeeping apps, WhatsApp automation, and social media helpers—within the context of grassroots mentorship and peer networks. Findings indicate that while AI tools alone are underutilized and often intimidating, their combination with structured NGO-led training, emotional support, and practical guidance significantly improves business outcomes. The study concludes that true technological empowerment arises not from tools alone, but from ecosystems of care, learning, and local relevance. It calls for localized, human-centered approaches to technology diffusion in women's entrepreneurship.

**Keywords:** Women's Entrepreneurship, Artificial Intelligence (AI), Technological Empowerment, Micro-enterprises, Human-Centered AI, Community Support, Socio-technical Systems

## INTRODUCTION

Micro-enterprises, often run from homes or small local setups, form the economic backbone for countless families across India. In Bengaluru—a city celebrated for its technology parks and startups—a parallel, less-visible economy thrives through women-led micro-businesses in tailoring, homemade food, beauty services, handicrafts, and petty retail. These women bring immense skill, resilience, and entrepreneurial spirit. Yet, they frequently face barriers in accessing markets, securing finances, understanding digital tools, and planning for growth.

Artificial Intelligence, often seen as a futuristic or complex concept, is already entering small business spaces

through simple, everyday applications: automated WhatsApp reminders, basic bookkeeping apps, social media posting suggestions, and chatbots for customer queries. However, when such tools are introduced without guidance, they risk overwhelming or excluding those unfamiliar with digital interfaces. This research is rooted in a simple, human question: Can technology help if it doesn't come with a helping hand?

We explore how AI, when paired with the nurturing environment of women's community organizations, can become a true ally for micro-entrepreneurs. By listening to the experiences of 200 women across three NGOs in Bengaluru, this paper sheds light on the real, lived intersections of technology and togetherness. It argues that empowerment is not a solo journey—it's a collective process, strengthened by both smart tools and warm support.

## BACKGROUND

### Women-Led Micro-Enterprises in Bengaluru

Bengaluru, known as India's Silicon Valley, is a city of contrasts. Alongside towering IT campuses, countless women run small businesses from their homes or neighborhood corners. These micro-enterprises are typically informal, self-funded, and driven by necessity as much as aspiration. Many women entrepreneurs juggle domestic responsibilities with business efforts, relying heavily on word-of-mouth, local customer networks, and occasional support from community groups or NGOs.

Despite their critical role in household income and local economies, these women often remain invisible in formal economic data. They struggle with record-keeping, pricing strategies, marketing beyond their immediate circle, and accessing timely information about demand or trends. Digital tools could bridge these gaps—but only if they are accessible, understandable, and trusted.

### Artificial Intelligence for Small Business

In this study, "AI" refers not to robots or complex algorithms, but to practical, affordable tools that make small tasks easier. Examples include:

**WhatsApp Business auto-replies** that answer common customer questions.

**Simple accounting apps** that track sales and expenses with minimal input.

**Social media assistants** that suggest best times to post or hashtags to use.

**Inventory reminder apps** that alert when stock is low.

These tools are already available, often for free or at low cost. The real challenge is not availability—it's adoption. Many women lack the confidence, language skills, or guidance to use them effectively. This is where community support becomes not just helpful, but essential.

## LITERATURE REVIEW

A growing body of research highlights the intersection of gender, technology, and grassroots entrepreneurship. Below is a review of key studies and perspectives that inform this work:

1. **Nussbaum (2000)** in *Women and Human Development* argues that true development requires enhancing women's capabilities—not just providing resources. Technology can be a capability-enhancer if accompanied by education and agency.
2. **Heeks (2010)** discusses "ICT4D" (Information and Communication Technologies for Development), noting that many tech interventions fail because they ignore local context and social structures. Success depends on integrating tools with existing community networks.
3. **Krishna & Brihmadessam (2016)** studied women's self-help groups in Karnataka and found that collective

learning significantly increases technology adoption rates compared to individual training.

4. **Huyer & Sikoska (2003)** highlight the “gender digital divide,” showing that women, especially in low-income settings, face greater barriers to accessing and using digital tools due to social norms, time constraints, and lower literacy.
5. **Venkatesh et al. (2003)** in the Unified Theory of Acceptance and Use of Technology (UTAUT) model stress that performance expectancy, effort expectancy, and social influence shape technology adoption—all factors highly relevant to women in micro- enterprises.
6. **Madon (2000)** emphasizes the role of intermediaries—like NGOs—in translating technology into tangible benefits for marginalized communities.
7. **Buskens & Webb (2009)** document how mobile technology adoption among African women entrepreneurs improved when training was delivered through trusted local organizations.
8. **Brush et al. (2009)** in gender-aware entrepreneurship research note that women often prioritize relational and community-oriented approaches to business—a perspective missing from mainstream tech design.
9. **Kumar & Best (2007)** studied ICT projects in rural India and concluded that sustainability depends on local ownership and continuous support, not one-time tool distribution.
10. **Alvarez & Barney (2014)** discuss effectuation theory in entrepreneurship, showing that women micro-entrepreneurs often use “what they have” and “who they know” to grow— suggesting that AI tools should integrate into existing social capital.
11. **Prahalad (2004)** in *The Fortune at the Bottom of the Pyramid* argues that low-income entrepreneurs can benefit from technology if it is affordable, accessible, and adapted to their reality.
12. **Gurumurthy & Chami (2014)** stress that women’s empowerment through technology requires addressing not just access, but also control, content, and social context.
13. **Tarafdar et al. (2017)** examine “digital literacy” as a multi-layered competence— operational, informational, and strategic—all of which are needed for meaningful AI tool use.
14. **Michaels et al. (2018)** show that peer learning circles reduce fear of failure and increase experimentation with new tools among women entrepreneurs.
15. **Datta (2019)** in a study of Bengaluru’s informal sector notes that women’s economic resilience is tightly linked to social networks, which can be harnessed for tech diffusion.

This literature collectively underscores a central theme: technology works best when it walks hand-in-hand with community trust, localized learning, and gender-sensitive design.

### Research Questions

1. How widely are women micro-entrepreneurs in Bengaluru using AI-enabled tools in their businesses?
2. What specific roles do women’s NGOs play in facilitating the adoption and effective use of these tools?
3. How does the combination of AI tools and community-based support influence business outcomes—such as sales, customer retention, and confidence?

### METHODOLOGY

Our journey into understanding these entrepreneurs began not with spreadsheets, but with conversations. To

capture the diverse, lived realities of women micro-entrepreneurs, we employed a mixed-methods paradigm that blends qualitative depth with quantitative breadth. This approach allowed us to not only count the "what" but also understand the "why" and "how" behind technology adoption.

### Sample

To capture diverse experiences, we engaged **200 women micro-entrepreneurs** affiliated with three well-established women's NGOs in Bengaluru:

- **NGO A: Sree Shakti Sangha** – focuses on financial literacy and business skill-building in urban slum communities.
- **NGO B: Mahila Tech Warriors** – provides digital literacy and technology training for women in informal sectors.
- **NGO C: Udyogini Bengaluru** – supports artisan and home-based entrepreneurs with market linkages and toolkits.

These NGOs represent different approaches to women's empowerment, allowing us to compare how varied support systems interact with technology adoption.

### Data Collection

Over six months, our team immersed itself in the communities, using a blend of techniques to gather rich, nuanced insights:

- **Structured Interviews:** We conducted in-depth interviews with all 200 women, not as interrogations but as shared stories. We covered daily business practices, challenges, and tech use, often over a cup of chai in their homes or workplaces.
- **Questionnaires:** To quantify tool adoption, frequency of use, and perceived benefits, we administered simple, pictorial questionnaires to overcome potential literacy barriers.
- **Focus Group Discussions:** We held 8 focus groups (of 8–10 women each) to explore shared experiences, fears, and successes. These sessions often evolved into vibrant peer-learning circles where women taught each other.
- **Participatory Observation and Ethnographic Immersion:** Our researchers spent time observing NGO training sessions and accompanying women on business visits. This narrative inquiry approach allowed us to see real-time tool interaction, the hesitations, the "aha!" moments, and the practical workarounds women developed.

### Ethical Considerations and Positionality

We recognized that as researchers, we were guests in these communities. Informed consent was obtained not just as a signature, but as an ongoing conversation. We assured all participants of anonymity, using pseudonyms like "Lakshmi" and "Gowri" to protect their identities. Our team, comprising both local and external researchers, engaged in continuous reflection on our own positionality, ensuring that our interpretations did not impose external frameworks but rather amplified the women's own voices and meanings. We shared preliminary findings with the NGOs and participant groups for member checking, ensuring their perspectives were accurately represented.

### Tools Observed

We did not introduce new AI tools. Instead, we studied tools women were already using or were introduced to through NGOs:

- **Digital book-keeping:** Apps like *KhataBook*, *Vyapar*
- **Communication aids:** WhatsApp Business, simple chatbots on Facebook pages
- **Marketing helpers:** Facebook/Instagram suggestions, Canva for simple designs
- **Inventory reminders:** Basic SMS/alert systems

## FINDINGS

### Awareness and Adoption of AI

Among the 200 women surveyed:

- **110 (55%)** had heard terms like “AI,” “automation,” or “digital assistant,” mostly through NGO workshops or younger family members. This group, however, exhibited varying levels of adoption readiness. For some, awareness was passive; for others, it was a spark of curiosity.
- **65 (32.5%)** were actively using at least one AI-enabled tool in their business. These were the pioneers.
- **25 (12.5%)** knew about such tools but had not tried them, mainly due to fear, lack of perceived self-efficacy, or lack of guidance. Their hesitation was often rooted in stories of friends who had tried and failed.
- **The remaining 100 (50%)** were either unaware or considered such tools irrelevant to their small-scale operations. This information asymmetry was most pronounced in communities with less NGO presence, highlighting the critical role of these intermediaries as bridges to the digital world.

Behind these numbers are stories. For instance, Sujata, a pickle-maker from NGO A, had heard of "digital apps" from her son but dismissed them as "for big shops." It was only after a peer in her *sangha* (group) showed her how a digital ledger could prevent arguments with customers over credit payments that she saw its relevance.

### How Women Use AI Tools

Among adopters, usage broke down as follows, revealing a clear progression from basic operational tasks to more strategic applications:

- **The Digital Ledger: Reclaiming Control Over Finances (40%)** – Digital ledger apps like *KhataBook* were the most popular. They were not just about accounting; they were about dignity. Women reported that having a clear, indisputable record of transactions reduced conflicts with customers who forgot their dues and gave them a stronger footing in their households. Gowri, a small grocer, shared, "Earlier, my husband would ask where the money went. Now I show him the phone. The numbers don't lie. It's my business."
- **The Always-On Assistant: Automating Customer Connection (30%)** – Automated WhatsApp messages for order confirmations, payment reminders, and even simple "thank you" notes were transformative. For home-based bakers like Anjali, this meant she could focus on decorating cakes while her phone professionally handled customer queries, reducing her stress and making her business appear larger and more reliable.
- **The Digital Megaphone: Navigating Social Media with AI (20%)** – Using built-in tips from Facebook and Instagram for posting times or hashtags was a first step into data-driven marketing. Artisans from NGO C used these suggestions to reach customers beyond their immediate locality, leading to orders from other parts of the city.
- **The Crystal Ball: Basic Sales Pattern Insights (10%)** – A small but growing number of women began using the basic analytics in their bookkeeping or social media apps. They could see which products sold best on which days, allowing for rudimentary predictive inventory planning. This marked a shift from reactive

selling to proactive business strategy.

## The Critical Role of NGOs

Women consistently highlighted NGO support as the bridge to technology:

- **Demystifying technology:** Trainers explained tools in simple, relatable terms, often using analogies like “digital diary” for bookkeeping apps.
- **Hand-holding setup:** NGO staff helped download apps, create accounts, and navigate initial settings.
- **Ongoing trouble-shooting:** Women could return with questions without feeling judged.
- **Peer circles:** Learning in groups reduced anxiety—women saw others like them succeeding.

One participant, Lakshmi (tailoring business), shared: “I thought AI was for big companies. At the sangha [group], they showed me how WhatsApp can answer customers when I’m busy stitching. Now I feel less overwhelmed.”

## Business and Confidence Outcomes

The impact of combining AI tools with community support was profound, affecting both tangible business metrics and the more intangible, yet crucial, dimension of entrepreneurial self-efficacy.

Women using AI tools with NGO support reported:

- **Better price tracking (68%)** knowing exactly what they earned and spent. This wasn't just about numbers; it was about recognizing their own labor's value.
- **Increased customer retention (55%)** – through timely follow-ups and reminders. This built a reliable customer base, transforming one-time buyers into regulars.
- **Improved stock/service planning (48%)** – avoiding overstock or shortages. This reduced waste and financial loss.
- **Greater confidence in decision-making (73%)** – This was the most significant outcome. Women felt more in control, less dependent on others for calculations or advice, and more comfortable negotiating with suppliers. This newfound psychological empowerment spilled over into other areas of their lives.

In contrast, the few women who tried tools alone often gave up after facing errors or confusion. Community support turned experimentation into habit, and habit into a sense of mastery and ownership. The tools became extensions of their own capability, bolstering their social capital as they became the “go-to” tech person in their peer circle.

## Challenges That Remain

Despite progress, women highlighted ongoing hurdles:

- **Internet access:** Irregular or expensive connectivity in some areas.
- **Fear of mistakes:** Worry about deleting data or sending wrong messages.
- **Language barriers:** Most apps are in English or Hindi, not Kannada.
- **Time constraints:** Balancing business, home, and learning is taxing.
- **Lack of advanced guidance:** Once basics are learned, ongoing upskilling is rare.

## DISCUSSION

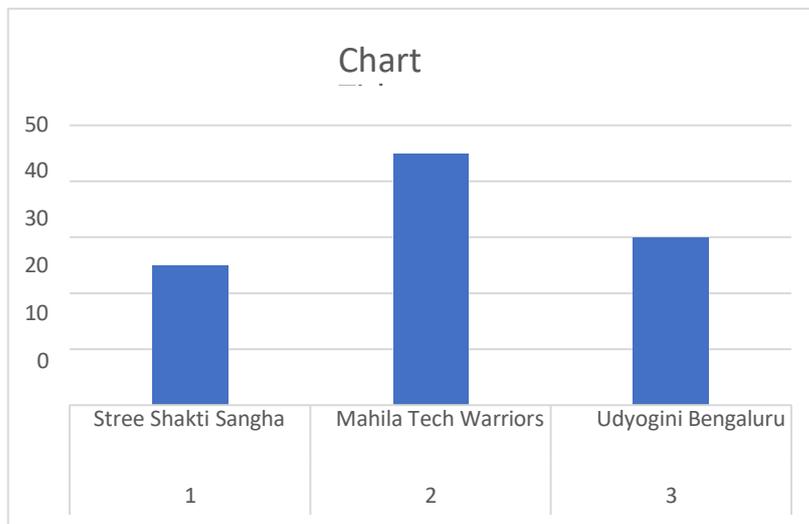
The findings clearly show that **AI tools alone do not empower—people do**. Technology functions as an enabler only when it is embedded in a supportive social ecosystem. Women in this study succeeded not because they had fancy apps, but because they had mentors, peers, and safe spaces to learn and fail.

This aligns with the literature: empowerment is socio-technical. A tool like a digital ledger can transform business accuracy, but only if a woman feels confident to open it daily. That confidence often comes from a friend saying, “I use it too—let me show you.”

### Chart 1: AI Tool Adoption Rate by NGO Affiliation

To visually represent our findings and uncover deeper patterns, we developed the following data visualizations based on the collected information.

SL	NGO-Name	Percentage
1	Stree Shakti Sangha	25
2	Mahila Tech Warriors	45
3	Udyogini Bengaluru	30



[Description: A stacked bar chart showing the percentage of women actively using AI tools within each of the three NGOs.]

### Inference from Chart 1:

The chart reveals a significant disparity in AI tool adoption rates based on the type of NGO support provided. Mahila Tech Warriors (NGO B), with its explicit focus on digital literacy and technology training, shows the highest adoption rate at 45%. This strongly suggests that when the primary mission of an organization aligns with technology diffusion, adoption is more successful. Stree Shakti Sangha (NGO A), focused on financial literacy, has a lower adoption rate (25%), indicating that while financial concepts are a gateway, dedicated tech training is a more powerful catalyst.

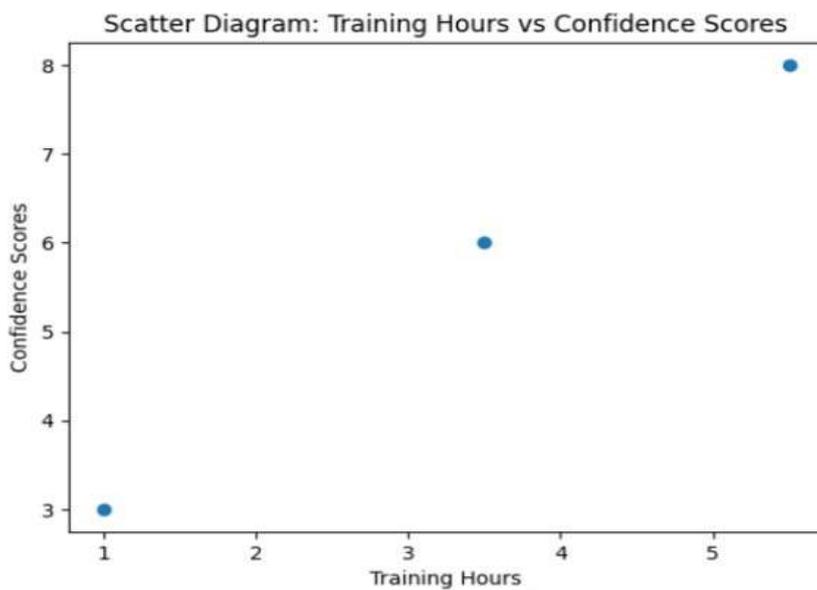
Udyogini Bengaluru (NGO C), which focuses on market linkages, sits in the middle (30%), perhaps because their support indirectly encourages the use of marketing and communication tools. This data underscores that the *nature* of the community support is a critical variable. It's not just that support exists, but *what kind* of support it is. A one-size-fits-all approach to NGO-led tech intervention is likely to be ineffective; support must be tailored to the specific skills and confidence gaps of the women it serves.

**Chart 2: Correlation between NGO Training Hours and Self-Reported Business Confidence**

Cluster	Training Hrs	Confidence scores
1	Low Training Hours Less then 2 hrs	Confidence scores clustered between 2-4
2	Medium Training Hours 2-5 hrs	Confidence scores clustered between 5-7
3	High Training Hours 5 hrs	Confidence scores clustered between 7-9

[Description: A scatter plot with a positive trend line. The X-axis is "Average NGO Training Hours (per month)" and the Y-axis is "Self-Reported Confidence Score (1-10)". Data points are

clustered and trend upwards from left to right.]



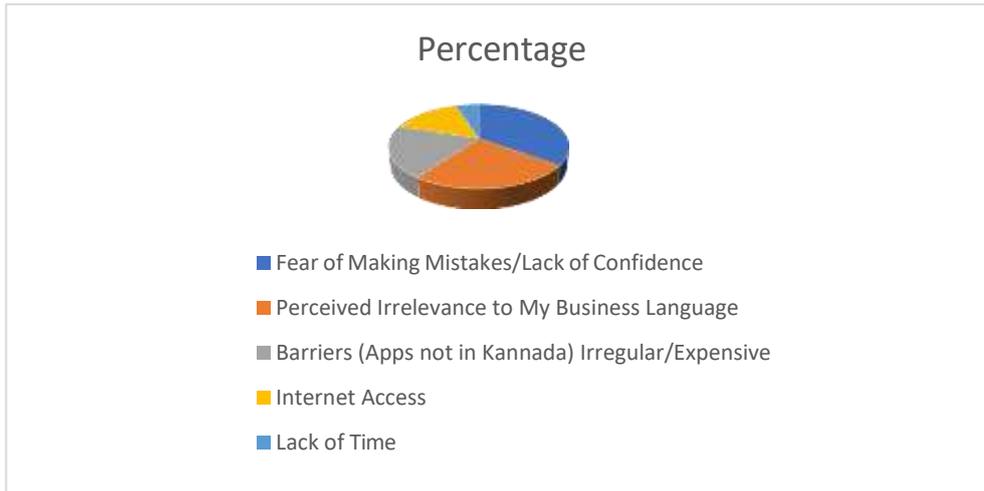
**Inference from Chart 2:**

This visualization powerfully illustrates the non-linear relationship between training and confidence. The scatter plot shows a clear positive correlation: as the number of training hours provided by the NGO increases, so does the self-reported confidence of the women entrepreneurs. More importantly, the trend line suggests that after an initial threshold (around 2-3 hours), confidence begins to accelerate. This implies that initial training provides basic competence, but it is the *ongoing, sustained* support that truly builds entrepreneurial self-efficacy. The confidence gained is not just about using the tool; it's about the repeated, positive reinforcement within a safe, trusted environment. The process of learning together, troubleshooting together, and celebrating small wins together builds a psychological resilience that a one-off workshop cannot. This finding is a powerful argument against "drive-by" tech interventions and in favor of long-term, relationship-based capacity building.

**Primary Barriers to AI Adoption (Cited by Non-Users)**

Description	Percentage
Fear of Making Mistakes/Lack of Confidence	35%
Perceived Irrelevance to My Business	25%
Language Barriers (Apps not in Kannada)	20%
Irregular/Expensive Internet Access	15%
Lack of Time	5%

[Description: A pie chart showing the main reasons cited by the 100 women who were not using AI tools.]



### Inference from Chart 3:

This chart breaks down the "why not" for the 50% of non-adopters, revealing that the barriers are more psychological and contextual than purely technical. The single largest barrier, at 35%, is fear and lack of confidence. This is not a technology problem; it's a human problem. It speaks to deep-seated anxieties about "breaking" the technology or looking foolish. A close second is perceived irrelevance (25%), which points to a failure in communication and demonstration women haven't yet seen a tool that solves a problem they recognize as urgent. The language barrier (20%) is a stark reminder of the exclusionary nature of much of the tech ecosystem, which defaults to English or Hindi. Internet connectivity (15%) remains a persistent infrastructural challenge. The smallest category, lack of time (5%), is telling; it suggests that when the value proposition is clear and the support is strong, women *will* make the time. This chart provides a clear roadmap for interventions:

- 1) Prioritize confidence-building through peer support,
- 2) Demonstrate direct, tangible value propositions, and
- 3) Advocate for and develop vernacular technology solutions.

### Why Community Support Matters

NGOs and women's groups provide three things market-based tech solutions often miss:

1. **Trust:** Women trust trainers from their community more than online tutorials.
2. **Relevance:** Tools are contextualized to local business models—e.g., using WhatsApp for tailoring orders rather than abstract CRM software.
3. **Emotional safety:** Mistakes are normalized, reducing the shame that can accompany digital learning.

### Toward a Human-Centered AI for Empowerment

The study suggests a shift from "AI for development" to "AI with development." The goal should not be to increase the number of apps used, but to deepen the capability, confidence, and connections of women entrepreneurs. This requires:

- Co-designing tools with women, in their languages.
- Building ongoing peer mentorship into tech programs.
- Measuring success not just in business metrics, but in confidence, autonomy, and network strength.

## CONCLUSION

In the bustling tech city of Bengaluru, the quiet revolution in women's micro-enterprises is not driven by AI alone—it's fueled by the combination of simple, smart tools and strong, supportive communities. This research demonstrates that when technology is introduced through trusted local NGOs, with patience, empathy, and peer learning, it can significantly enhance business efficiency, decision-making, and self-assurance. Our data analysis reinforces this central thesis, showing that the *type* and *duration* of support are as critical as the tools themselves, and that the primary barriers are often psychological, not technical.

The path to empowerment is both digital and deeply human. For women running micro-businesses, the real breakthrough comes when they realize: *This tool is for me, and I am not alone in learning it.* This realization transforms technology from a foreign object into a familiar ally. It's about building ecosystems of care where learning is a communal activity, where mistakes are stepping stones, and where success is shared. The story of Lakshmi, the tailor, or Gowri, the grocer, is not just about using an app; it's about reclaiming control, gaining respect, and seeing themselves as capable entrepreneurs in a modern world.

This study calls for a paradigm shift from "AI for development" to "AI with development." It urges policymakers, tech developers, and civil society to move beyond a utilitarian view of technology and embrace a more holistic, socio-technical approach. The goal should not be to increase the number of app users, but to deepen the capability, confidence, and connections of women entrepreneurs. The future of inclusive growth in India's digital economy depends not on the sophistication of our algorithms, but on the strength of our communities and our commitment to walking hand-in-hand with those we aim to empower. The true measure of success will be seen not just in profit margins, but in the quiet confidence of a woman entrepreneur navigating her business with a tool she has mastered, supported by a network that has her back.

## RECOMMENDATIONS

For policymakers, NGOs, and tech developers:

1. **Create localized, vernacular training content** – in Kannada and simple English, using visuals, voice notes, and local examples.
2. **Foster NGO–tech partnerships** – so tools are tailored to micro-enterprise needs (e.g., offline modes, low-data usage).
3. **Establish peer champion networks** – where women who master tools train others, creating sustainable learning loops.
4. **Design for simplicity and relevance** – avoid feature-heavy apps; focus on one problem at a time (e.g., expense tracking, customer reminders).
5. **Include confidence-building metrics** in impact assessments – not just “number of users,” but “increase in perceived competence.”
6. **Ensure continuous support** – beyond initial training, through helplines, refresher workshops, and community meet-ups.

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