Development of AI-Powered Chatbot for Financial Inclusion of Underserved Population in Northern Nigeria

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Abstract – Financial inclusion is the availability and accessibility of financial services and products to individuals and businesses, regardless of their income level or location. Financial inclusion has remained a major challenge in Northern Nigeria, where a significant percentage of the population is either unbanked or under-banked as a result of the limited access to financial services, low level of financial literacy, and socio-cultural bottlenecks. To address this, the study developed an AI-powered chatbot, *Naija BankPal*, which is designed to bridge the financial inclusion gap among the underserved population in Northern Nigeria by providing access to financial orientation in English, Hausa, and Pidgin languages. Leveraging Natural Language Processing (NLP) technologies, *Naija BankPal* provides a user-friendly, interactive platform that provides financial guidance on banking services, types of accounts, savings, and investment opportunities. The chatbot adopts a dual deployment strategy, using both online platforms (through WhatsApp and Telegram) and offline services (via USSD-based services), effectively addressing the limitations of internet accessibility and digital literacy. This study suggests the need for effective support frameworks that will ensure the integration of AI-driven solutions into national financial inclusion strategies, with emphasis on digital literacy promotion, building trust, and investing in infrastructure. This paper recommends the fostering of partnership among relevant stakeholders, while continuous improvement and regular evaluations of the chatbot's performance should be ensured to achieve a sustained impact.

Keywords: Financial Inclusion, AI-Powered Chatbot, Digital Financial Literacy, Natural Language Processing.

1 Introduction

Financial inclusion of citizens remains a major component to the economic development of any nation. It explains the availability and accessibility of financial services and products by individuals and businesses, regardless of their income level or location. Financial inclusion has been a major challenge in Northern Nigeria (Muhammed et al., 2022), as a significant number of the population are either unbanked or under-banked. They are faced with challenges like lack of or limited access to financial institution services, poor financial literacy, and socio-cultural limitation (Adebisi & Oyedele 2022).

Financial exclusion has far-reaching implications, like dearth of economic opportunities, increase in level of poverty, and poor economic growth (Muhammed et al., 2022). However, the

advancement and adoption of modern technologies, specifically in the financial sector, has been posited to have played a major role in advancing the economy of many nations (Dauda et al., 2025). The current advancements in Artificial Intelligence (AI) has brought about innovative solutions that can address the financial exclusion challenges (Mutambara 2025). Specifically, AI-powered chatbots can be deployed to provide financial services orientation to the underserved communities, in northern Nigeria, in particular. The chatbots are increasingly emerging as transformative tools that can be used to tackle the identified financial inclusion challenges in the underserved communities (Nwanko et al., 2020), as they offer a convenient, user-friendly, as well as easily accessible alternative platforms for accessing financial services and information (Mutambara, 2025; Pugh Jones, 2023).

However, deploying AI-powered chatbots in Northern Nigeria has the potential to address the financial inclusion challenge by offering efficient and accessible financial orientation and services to the underserved population (Muhammed et al., 2022). The chatbots have the capacity to provide information as well as guide users using basic banking operations, savings plans, and investment options, thereby making financial services more interesting, understandable, and accessible (Salem, 2024). Furthermore, by employing machine learning and natural language processing techniques, chatbots have unique capacity to offer financial services, particularly to the unbanked and under-bank population by using mobile platforms to engage with users in their informal/native languages, provide them with customized financial guidance, and customised financial guidance, and enable transactions without relying on physical bank branches (Udeh et al., 2024), which is essential in a nation where a great number of individuals lack access to conventional banking (Olowookere & Adewole, 2021).

The implementation of AI-powered chatbots for financial inclusion in Northern Nigeria faces several challenges. These include, issues related to trust, privacy, and the digital literacy gap, which must be addressed to guarantee that these transformative technologies are fairly accessible to all population segments, hence fostering financial inclusion in underserved areas. However, this article examines the potential of AI-driven chatbots to enhance financial inclusion of the underserved population in Northern Nigeria. The specific objective of the study include:

i. Investigation of the available AI-powered chatbots for financial inclusion of the underserved population in Northern Nigeria.
ii. Design and development of a suitable AI-powered chatbot for financial orientation of underserved population in Northern Nigeria.

2 Literature Review

The section provides the conceptual, empirical, and the theoretical reviews of the paper, based on the context and objectives of the research.

2.1 Conceptual Review

Financial inclusion is crucial for economic development, particularly focusing on Northern Nigeria. It pertains to ensuring that people, regardless of their income level, geographical location, or history, are able to access cheap and financial services such as servings, loans, and employment mechanisms (Dauda et al., 2025). The objective is to tackle the challenges, such as inadequate banking infrastructure, limited financial literacy, or cultural barriers, enabling individuals, particularly the underserved population in Northern Nigeria, to engage comprehensively in the economy, enhance their livelihoods, and attain financial autonomy.

Leveraging on AI-powered chatbots presents a great opportunity to bridge the gap by providing accessible financial services and relevant orientation. This article explores the related studies on available AI-powered chatbots, and the design and development of a suitable AI-powered chatbot for financial orientation and inclusion of the underserved population in Northern Nigeria.

Available AI-powered Chatbots for Financial Inclusion in Northern Nigeria

A chatbot can simply be described as a computer programme or an AI which can conduct conversations with the use of audio or text. In Nigeria, chatbots are deployed across many platforms, offering services to different classes of users in multiple languages (Mogaji et al., 2020). The chatbots use Natural Language Processing (NLP) to facilitate seamless interactions, enabling the users to perform banking transactions, inquire about services, and receive personalized financial advice.

In the recent time, banks in Nigeria have developed and deployed AI chatbots to enhance their service delivery. The banks and their respective chatbot include: United Bank for Africa Plc – Leo, Zenith Bank - Ziva; Fidelity Bank plc - Ivy; First City Monument Bank - Temi; Access Bank - Tamada; Heritage Bank - Octopus and Keystone Bank's Oxygen chatbot. Though, these show an encouraging trend in the development and deployment of chatbots by Nigeria banks, they are developed and customized to run based on their respective bank's services. This may bring about bias and could be viewed as a promotional tool for a particular bank. Moreover, they are mostly customer focused, giving less attention to the financial inclusion of the unbanked and underbanked population. However, the need to design and develop an AI powered chatbot that is not any bank dependent, with a focus on the financial inclusion of the underserved population, is imperative.

The deployment strategies usually involve integrating the chatbots into existing digital infrastructures, while ensuring that they are accessible via commonly used channels like the social media and messaging Apps. This approach enhances reach as well as the engagement, particularly among the younger demographics and tech-savvy individuals. Furthermore, AI-powered chatbots usually operate 24hours - all day round, thereby providing continuous supports and reducing the need for physical presence of bank branches in the remote areas (Okeke et al., 2024).

Design and Development of AI-powered Chatbot for Financial Orientation in Northern Nigeria.

The design of AI-powered chatbots for financial inclusion, necessitates a user-centric approach, emphasizing accessibility, language compatibility, and cultural relevance. Moreover, the development of an AI-powered chatbot designed to serve the underserved populations in Northern Nigeria, involves understanding the unique challenges faced by the concerned people, which include: low level of literacy, limited internet access, and the cultural nuances. Hence, it is advised that the design considerations of the chatbot should help to facilitate seamless interactions in an informal languages like the local dialects, in order to accommodate users with limited reading skills (Candello et al., 2024).

However, a suitable chatbot, in this regards, should offer financial orientation modules, using informal languages like Pidgin English, and Hausa language, in addition to English Language.

This is to improve financial literacy, covering topics like the available banking services, types of banks, types of account, savings, credit management, investment opportunities, among others.

2.2 Empirical Review

Integrating AI-powered chatbots into financial services, in a bit to enhance financial inclusion, has garnered great significance, particularly among the underserved populations. This paper reviewed relevant studies conducted to assess the availability, design and development of AI-powered chatbots for financial inclusion, with a focus on the underserved population in Northern Nigeria.

Some recent studies have assessed the adoption of AI-powered chatbots in the Nigerian banking sector, highlighting their roles in enhancing customer experience and operational efficiency. The work of Mogaji et al. (2020) examined the digital transformation in financial services provision in

Nigeria, with a focus on chatbots adoption. They suggested that chatbots have the capacity to improve customer engagement and the accessibility to financial services, consequently promoting financial inclusion. In the same vein, Okeke et al. (2024) emphasized the potential of AI-powered customer experience optimisation in enhancing the financial inclusion of underserved communities. The AI-powered chatbots has the potential to provide personalised financial services, thereby making banking services more accessible to people in the underserved communities like the villages.

Furthermore, the development of AI-powered chatbots, designed specifically to cater for the needs of the underserved populations, requires an in-depth understanding of the local contexts. Candello et al, (2024) carried out a research on designing multi-modal conversational AI financial systems, with a focus on understanding the sensitive values of women entrepreneurs in Brazil. The study emphases the importance of context-aware chatbot development. Even though this study was done in Brazil, its insights into culturally sensitive AI solutions are applicable in Northern Nigeria. More so, Hawkins (2024) advocated leveraging AI-powered automations in order to enhance financial inclusion. The study highlighted the importance of deploying AI-powered solutions that are user-friendly and accessible for the benefits of the underserved population. Hawkins equally recommended the need to provide chatbots that can work on basic mobile devices, considering the fact that there is limited access to advanced technologies in some, if not most, of the underserve communities.

The empirical evidence shows significant research efforts and suggests that AI-powered chatbots hold significant potential in promoting financial inclusion and literacy among underserved populations. Research shows that, most of the AI-powered chatbots for financial inclusion, currently operating in Nigeria, are largely bank-based and customized mainly to serve the existing customers of the owner bank, with features tailored towards ensuring enhanced and customer-friendly services to the bank's customers. Consequently, the financial orientation towards enhancing and ensuring financial inclusion of the unbanked and underbanked (underserved) populations, particularly in Nothern Nigeria, are not adequately considered and addressed by the Chatbots. However, this paper introduces an AI-powered chatbot, named "Naija BankPal", designed to be independent and not customized to a particular bank, but for the general use of the masses, particularly, the underserved population in Northern Nigeria.

Naija BankPal Chatbot

Naija BankPal chatbot is a solution developed to assist users in Nigeria with banking-related queries using conversational AI. The Naija BankPal is designed to provide accurate, generic, easy-to-understand, and user-friendly responses, giving the users the option of conversing with the chatbot in English, Hausa, or Pidgin English language, thereby making banking information accessible to a broader audience, particularly the underserved populations. By leveraging advanced Natural Language Processing (NLP) techniques, Naija BankPal chatbot is designed to bridge the knowledge gap between the underserved population and the financial services, particularly in Northern Nigeria, by facilitating seamless interactions, easy access to inquire about bank services, and receiving personalized financial orientation. Hence, promoting financial literacy and inclusion in a culturally relevant manner.

2.3 Theoretical Review

The deployment of AI-powered chatbots for financial inclusion draws from some theories that explain technology adoption and financial inclusion. Hence, the theoretical review of this study includes the Technology Acceptance Model (TAM), Diffusion of Innovations Theory (DOI), Financial Inclusion Theory (FIT), and the Capability Approach. Together, these theories formed the theoretical framework and provide a comprehensive basis for understanding how AI can be leveraged to address financial exclusion among underserved populations in Northern Nigeria.

The TAM explains how users adopt new technologies based on their Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis, 1989). In the context of financial inclusion, AI-powered chatbots must be able to demonstrate utility in simplifying complex financial processes, provide relevant information and financial orientation services, as well as ease of use for populations with low technical expertise. Trust and cultural factors also influence adoption in regions with underserved populations, as highlighted in extensions of TAM (Venkatesh & Bala, 2008). Hence, Naija BankPal chatbot developed to be independent, with a general use nature, which equally considered regional factors, has high potential of gaining the trust and adoption among the people.

Furthermore, DOI explores how innovations spread within a community through stages such as awareness, interest, evaluation, trial, and adoption (Rogers, 2003). For AI-powered chatbots, early adopters among the underserved populations, can play a crucial role in creating awareness and increasing trust among the people in their communities. Factors like compatibility with the local cultural practices and relative advantage, are considered very important in ensuring successful diffusion of the Naija BankPal chatbot. Moreover, the Capability Approach, developed by Sen in 1999 provides a framework for evaluating how tools like the AI-powered chatbots can improve the capabilities and real freedom of individuals. Moreover, financial inclusion efforts are not just about the provision of access to services, but to empower individuals in making informed financial decisions. The theory highlights the Naija BankPal chatbot's potential of increasing the users' capabilities by improving financial literacy as well as enabling easy access to financial orientation and services that were hitherto unattainable.

FIT also posited that equitable access to affordable and effective financial services is very important in reducing poverty and ensuring economic development (World Bank, 2018). FIT emphasises that financial inclusion must be achieved through accessibility, availability, and affordability of financial products and services, especially as it concerns the underserved population. In the recent time, the extensions to FIT incorporate the roles of digital innovations, like AI and banking, as tools to overcome the traditional barriers like lack of literacy, geographical distance, and financial literacy (Demirguc-Kunt et al., 2022).

The theoretical framework of the study integrates TAM, DOI, Capability Approach, and FIT, in order to offer a holistic understanding of the way the Naija BankPal chatbot can drive financial inclusion and orientation, particularly in Northern Nigeria. The framework combined FIT with the established models of technology adoption and empowerment, in order to provide a comprehensive lens to help understand the development and deployment of the Naija BankPal chatbot. The combined theories emphasised the need for cultural relevant, accessible, as well as empowering solutions with the potential to address the peculiar challenges faced by the underserved populations in Northern Nigeria. This justifies the significance of this research.

Hence, this paper presents an AI-powered chatbot that aligns with the combined theories by offering a low cost and accessible solution for the underserved populations, so as to gain access to relevant financial orientation and take advantage of various financial services. Naija BankPal chatbot has the potential to effectively and directly address the three core pillars of financial inclusions (availability, accessibility, and, affordability), through the provision of real-time assistance using simple languages and accommodating users with low digital literacy, particularly in the underserved communities in Northern Nigeria.

3 Methodology

The development process of Naija BankPal chatbot involved selected number of tools and technologies. The backend development was implemented using python, leveraging the flask framework for building the chatbot's structure. Python's package manager called pip, was used

for managing the dependencies. Database integration was done suing MySQL, while the administrative tasks was managed with phpMyAdmin.

The frontend development was done using HTML, CSS, and JavaScript, while the Bootstrap framework provides responsive design and improved user experience. Ajax was equally employed for seamless API integration, whereby enabling dynamic interaction between the frontend and the backend systems. Furthermore, the development environment adopted Visual Studio Code and Sublime Text as the Integrated Development Environment (IDEs). The application was hosted using cPanel with uWSGI, which serves as the webserver. The setup, therefore, ensures security, scalability, as well as reliable performance.

In order to maximize the accessibility and usability of Naija Bankpal chatbots, it was designed to be deployed through both online and offline channels. The online option involves the integration of the chatbot with the popular messaging applications, which are the WhatsApp and Telegram, where users can interact seamlessly through the selection of a suitable language option from either of English, Hausa, or Pidgin English. On the other and, the offline option utilizing USSD-based services, allows the users, who do not have access to internet, to interact with the chatbot through the use of short codes on basic mobile phones.

With the robust combination of tools and the dual deployment strategy, Naija BankPal chatbot leverages on the widespread adoption of the messaging platforms in Nigeria. Thereby ensuring that it reaches a wider and diverse audience, thereby bridging the digital divide and promoting financial inclusion across Nigeria, while ensuring a familiar and user-friendly experience.

4 Findings

This section present discussions on the different features of the developed AI-powered chatbot named Naija BankPal, designed for the purpose of enhancing financial inclusion of the underserved population in Northern Nigeria.

Figure 1 shows the screenshot of the homepage of the Naija BankPal chatbot. The homepage features include five sections of the chatbot, which include:

i. Bank accounts and what they are used for
ii. The types of banks in Nigeria
iii. The name of different banks in Nigeria
iv. The benefits of having a bank account
v. What you need to open a bank account

At a click of any of these sections, the chatbot takes the user to the interactive page where user can get the needed knowledge and answers to queries related and regarding the selected section.

In the same vein, figure 2 displays the three language options of the Naija BankPal chatbot, which include: English, Hausa and Pidgin. This feature makes it possible for the chatbot to serve many users, considering the target populations in Northern Nigeria. However, all the sections and subsections of Naija BankPal chatbot can be displayed and engaged in any of the three languages and get the same unbiased responses based on the users preferred option. Furthermore, this feature makes the chatbot more user friendly, thereby ensuring better understanding and achievement of the aim of enhancing the inclusion of the underserved population.

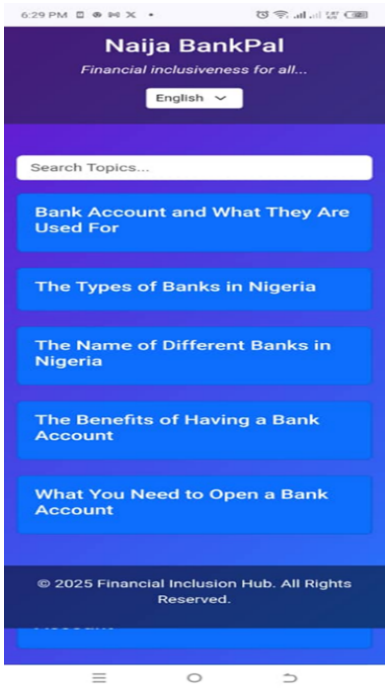

Fig. 1. Home page of the Naija BankPal chatbot.

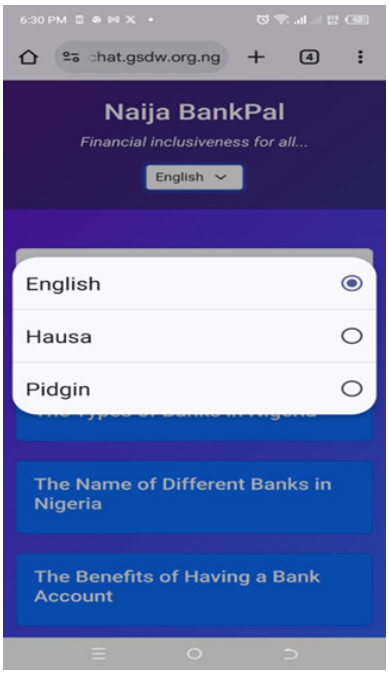

Fig. 2. The language options of Naija BankPal chatbot.

Figure 3 is an extension of figure 2, showing the three language options of Naija BankPal chatbot. Figure 3 displays the homepage of the chatbot in each of its three different language options. However, the user can select a preferred language or switch to another language, among the available options, at any stage, section or subsection of the chatbot to aid improved understanding, user friendliness, and enhance efficiency.

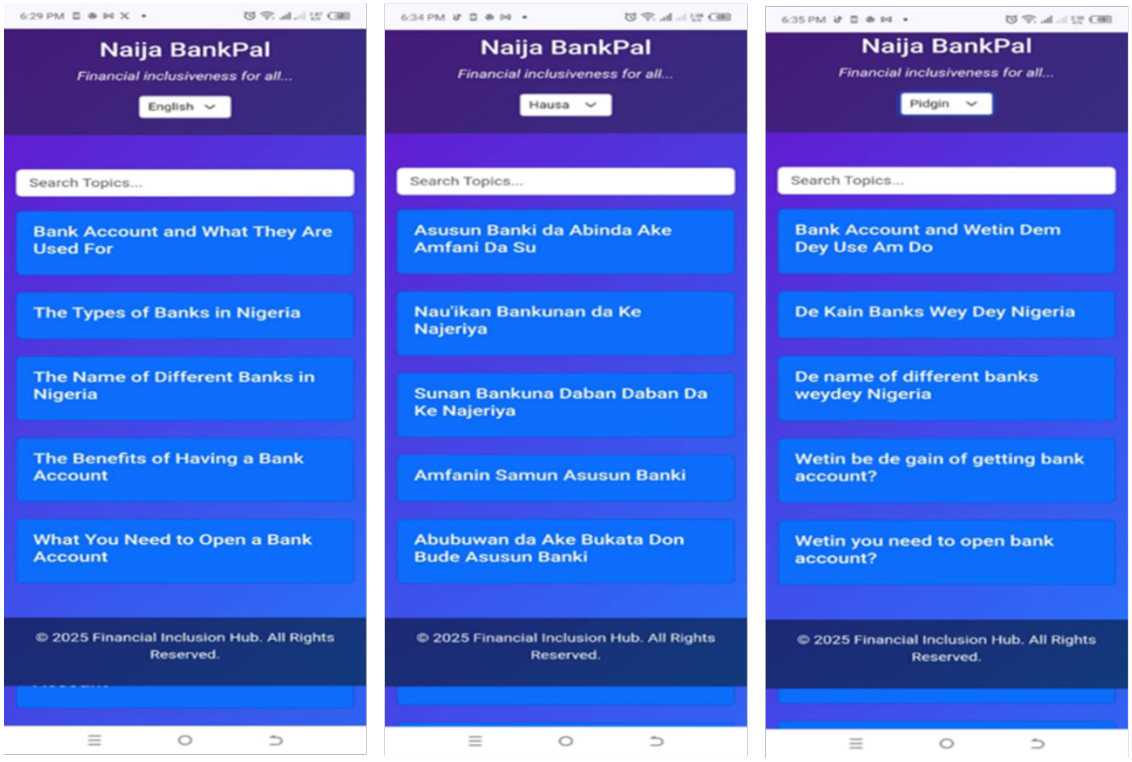

Fig. 3. Home page of the Naija BankPal chatbot display in each the three language options (English, Hausa, and Pidgin-English).

Figure 4 shows the content of the first section out of the five sections listed on the homepage of the chatbot. That is, when any of the five main section of the homepage is clicked, it displays the subsection under it, which also has options and an interactive interface. However, Figure 4 displays the options under the first section on the home page that reads "Bank account and what they are used for". These options include: What is a Bank? What is a Bank account and what is it used for? Major types of Bank accounts, and the interactive interface for further queries. While Figure 5 shows the explanation that is displayed when the option "What is a Bank?" under the section "Bank Account and What They Are Used For" is clicked. In the same vein, relevant and respective explanation equally display whenever any other option of the subsection (for example; "What is a Bank Account and What is it Used For?", or "Major Types of Bank Account") is clicked.

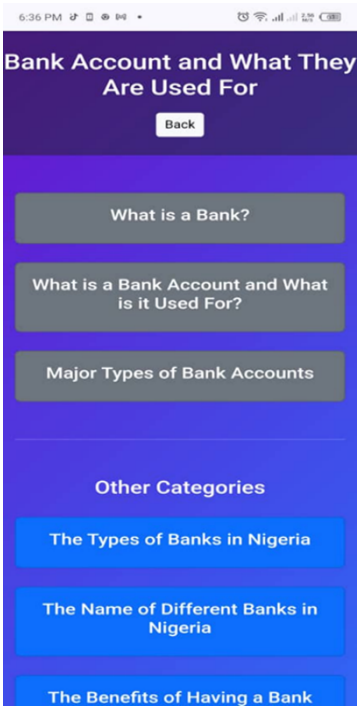

Fig. 4. The options under the subsections on "Bank Accounts and What They Are Used For"

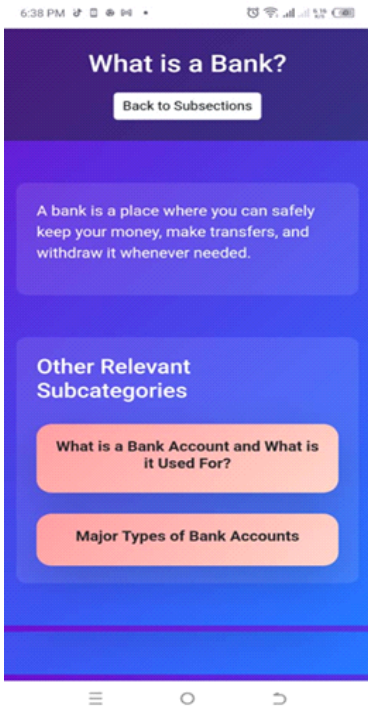

Fig. 5. Screenshot showing the explanation/response of the option/question: "What is a Bank?"

5 Conclusion, Recommendations and Policy Implication

5.1 Conclusion

The development of Naija BankPal demonstrates the potential of AI-powered chatbots to bridge the financial inclusion gap in Northern Nigeria. By providing financial orientation in accessible languages such as English, Hausa, and Pidgin, the chatbot ensures inclusivity for underserved populations. Naija BankPal's dual deployment strategy, encompassing both online platforms like WhatsApp and Telegram and offline USSD-based services, addresses the challenges of digital literacy and limited internet access. The chatbot's user-friendly design and ability to deliver unbiased financial guidance align with the broader goals of promoting economic growth, enhancing financial literacy, and empowering communities in Northern Nigeria

5.2 Recommendations and Policy Implication

This paper recommends that a continuous improvement of the chatbot, through users' feedback, should be encouraged in order to ensure its efficiency and sustainability. This is very important for refining interaction refining, ensuring cultural sensibility, and maintaining linguistic accuracy, with specific focus on the underserved population in Northern Nigeria. Likewise, building partnerships with the financial institutions, telecommunication companies, as well as the government agencies, will foster sustainable support for the chatbot, while aligning it with the national financial inclusion strategies.

It is further recommended that educational campaigns should be launched in order to raise necessary awareness about the functionality of the Naija BankPal chatbot and its benefits. This will make the users to gain more confident in adopting the solution. Moreover, regular monitoring and evaluation of the performance of the chatbot will also help to provide actionable insights to measuring its impacts on financial literacy and inclusion, thereby ensuring that its set goals remain achievable and impactful.

This paper underscores the important role of technology in promoting financial inclusion, particularly in the underserved communities. Policymakers can however, leverage on AI-powered solutions like Naija BankPal in order to bridge the gap in accessing financial services by incorporating of this kind into the national financial inclusion frameworks. Moreover, if policies that can address digital literacy and trust issues are ma de available, they will further empower the underserved populations to embrace the Naija BankPal chatbot, which could help to foster economic growth and social equity in Northern Nigeria and beyond.

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