EFFICACY OF THE NON-DIGITAL UGANDAN BANKNOTE IDENTIFIER

BY

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DECLARATION

I, Ayoli Moses, hereby declare that this is my original work and has never been submitted for consideration for a Master's Degree at any University or other higher Education Institution

AYOLI MOSES: …… Date: …….

APPROVAL

This certifies that the research dissertation has been overseen by us and has our approval for submission and examination.

…… Date ……

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DEDICATION

This work is dedicated to all individuals who are blind and face daily challenges in earning their livelihoods, particularly in conducting transactions with currencies that are difficult for them to identify.

ACKNOWLEDGEMENT

Work of this nature involves so many categories of people who normally contribute in one way or the other, however not everyone can be singled out by way of appreciation and salutation but notably I am highly indebted to my supervisors my supervisors Dr. Odette Niyisabwa and Dr. Eron Lawrence for their generous constructive guidance, support and encouragement through the process of this study. Thirdly, I thank my colleagues whose positive criticism culminated in writing up what constitutes the content of this book. I cannot forget the generous Lecturers and persons who are blind who responded to my interviews.

God bless them abundantly

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LIST OF ACRONYMS

ATM: Automatic Teller Machine

BoU: Bank of Uganda

IT: Information Technology

MoGLSD: Ministry of Gender Labour and Social Development

TAM: Technology Acceptance Model

U.S: United States

UBOS: Uganda Bureau of Statistics

ABSTRACT

This study investigated the efficacy of the non-digital Ugandan Banknote identifier. The research aimed to evaluate the accuracy, user-friendliness, and necessary modifications of this tool to facilitate independent financial transactions for people with blindness. Despite the innovation of the non-digital Banknote identifier, it's mass production, circulation, and usage have not been fully realized, thereby prompting this study. An experimental research design was employed, involving an experimental group using the identifier and a control group without it. This setup enabled a comparative analysis of the efficacy of the identifier. Data collection combined quantitative and qualitative methodologies through triangulation, incorporating in-depth interviews and statistical analysis. Findings revealed that 88.9% of respondents affirmed the accuracy of the non-digital identifier, though 11.1% preferred traditional methods due to doubts about its reliability. Before the introduction of the identifier, persons with blindness relied on assistance from others or tactile methods, often leading to inaccuracies and potential exploitation. The identifier has significantly enhanced the accuracy and independence of persons with blindness in financial transactions. Regarding user-friendliness, 88.8% of respondents adapted to the device within a week. However, challenges such as difficulty inserting old or weak Banknotes and the inability to detect counterfeit notes were reported. Despite these issues, the majority of respondents found the device significantly useful for daily transactions. Respondents suggested several modifications to improve the usability of the device, including using durable materials such as wood or metal, increasing the size, adding tactile lines, and incorporating a talking feature to announce denominations. These recommendations align with previous findings emphasizing the importance of tactile features on currency for persons with blindness. The study concludes that while the non-digital Banknote identifier is an effective tool for persons who are blind, there is a need for further improvements and increased awareness to promote its adoption. Enhancing the durability of the device, incorporating additional tactile features, and exploring digital solutions could further facilitate financial independence and security for persons who are blind in Uganda.

CHAPTER ONE

INTRODUCTION

1.0 Introduction

The study investigated the efficacy of the non-digital Ugandan Banknote identifier, focusing on its accuracy, appreciation, and potential need for modifications. This chapter covers the following aspects: background of the study, statement of the problem, purpose and objectives of the study, research questions, scope, and significance of the study.

1.1 Background to the Study

In Uganda, UBOS, (2014) reveals that there are 1,195,937 persons with visual impairment. Among these, 1,084,254 individuals experience moderate visual impairment, while 111,683 suffer from severe visual impairment. This significant number highlights the need for enhanced healthcare services, support systems, and inclusive policies to improve the quality of life for those affected by visual impairments in the country.

Blindness imposes a number of limitations on the quality of one's life, such as limited access to printed information including Banknotes. Furthermore, it limits information availability, impedes the development of physical, verbal, emotional, social, and cognitive skills, lowers productivity and workforce involvement, and raises the prevalence of anxiety, depression, social isolation, and mobility issues. Furthermore, blindness causes significant financial costs because it makes some duties impossible to complete. All parties must act in a timely and suitable manner to address these issues (Dunuwila et al., 2023).

The inability of people who are blind to differentiate between different denominations of paper money stems from the fact that Banknotes have similar textures and sizes. In order to solve this problem, technology can be extremely helpful in giving people who are blind a sense of security and assurance while interacting with money. For people who are blind, achieving financial independence and literacy requires overcoming many obstacles and coming up with original solutions to daily problems. There are several obstacles involved in simple tasks such as calculating money, using ATMs, paying taxes, and paying bills. As a result, the community of people who are blind as a whole loses out on employment opportunities (Lederman & Hamilton, 2002).

In 1966, the Bank of Uganda Act was passed by the Ugandan government, giving the bank the sole authority to print, distribute, and destroy coins and Banknotes. To fulfill popular demand, the Bank manages the bulk distribution. The East African shilling gave way to Uganda's first coinage, which was introduced in 1966. With the most recent series debuting in May 2010, the currency has undergone seven changes since then. Yet unlike those in Canada and India, Ugandan Banknotes do not include tactile indications for people who are blind , which puts people who are blind at risk who rely on sighted aid to recognize money (Monitor, 2021).

Due to their distinctive sizes and textures, different coin denominations are easily recognized by blind people. The majority of Uganda's cash, Banknotes, present a problem because people who are blind are unable to view their different sizes and colors. They become vulnerable to exploitation since they are unable to discern different denominations as a result. Evil people frequently deceive people who are blind by giving them less change or stealing some of their money. Due to their

inability to identify Banknote s, they are unable to work in jobs involving handling money and are hence ineligible for many financial benefits (Ganiger et al., 2023).

Due to their incapacity to recognize Banknotes, many people who are blind are denied access to ATM cards and mobile banking services, among other banking services, under the guise of shielding them from financial losses. But this limitation makes it impossible for individuals to use other private money management strategies, which significantly reduces their economic independence. Because of this, people who are blind frequently lack the resources needed to manage their finances on their own and encounter major obstacles in their quest for financial autonomy (Hassan et al., 2020).

Owing to the several difficulties presented by inaccessible Banknote s, several nations and individuals have taken preventative action to deal with this problem. The I-Bill U.S. Banknote Identifier has gained popularity in the US as a tool for identifying cash. Via voice or vibration patterns, this tiny, portable device gives information about cash denominations. When a person who is blind puts one end of the bill into the machine and hits a button, the denomination is announced by the machine. Ugandan money is among the international Banknotes that the I-Bill is unable to recognize. Although it is costly because to its usage of a contact image sensor, the US government offers visually impaired people free use (Vivek et al., 2022).

People who are blind need visual help to sort and divide the money into distinct pockets or folds in order to help them identify Banknotes. One could, for example, fold 20,000-shilling notes; leave 1000-shilling notes unfolded, or fold

some notes lengthwise and others in half. Maintaining distinct compartments for different denominations is beneficial to some people. It is typical for people who are blind to indicate the denomination as they pass money to others, such a shopkeeper. Many people would rather not use big amounts in order to prevent being conned (RBN, 2022).

But there are drawbacks to this approach. People who are blind must take care to avoid mixing up different currencies while exchanging money because they are unable to confirm the denomination. A Banknote that is dropped has the potential to readily unfold, making it challenging to figure out where it was before or how to properly fold it. It is also practically hard to manage money without the assistance of the sighted; therefore, people who are blind are forced to disclose their financial situation to others. As a result, a lot of people have been defrauded by dishonest individuals when making transactions or asking for help. People who are blind face several challenges when it comes to controlling their finances since they lack financial independence and security (DNB, 2009).

Many technological tools have been developed in response to the difficulty of helping people who are blind identify Banknotes. These tools include the Money Decoder by Quinita Noronha, the Money Identifier from the US Bureau of Engraving and Printing, and software such as LookTel Money Reader for iPhone, iPod Touch, and Mac, as well as Cash Reader for iOS and Android. These instruments are able to recognize Banknotes and declare their denominations aloud. However, lack of digital literacy skills among people who are blind limits their adoption in Uganda. In addition, these tools and programs are unaffordable given the financial circumstances of many people who are blind in the nation and are mainly intended to identify foreign currencies (Perkins, 2016).

An inventive non-digital Banknote identifier that is 3D printed has been created in an attempt to help blind Ugandans who struggle with Banknote identification. This gadget provides a different way to recognize Ugandan money. Under the guidance of Moses Ayoli who is a teacher with visual impairment, a staff member of Oysters and Pearls Uganda modeled the device. The goal of the non-digital identification is to enable people who are blind to live freely and actively engage in entrepreneurship, financial literacy, and societal advancement. A slot and a guide are included in this plastic pocket gadget to assist users in inserting and withdrawing cash via it. In order to guarantee that every folded note finishes on the appropriate line, the front features six tactile lines that correspond to the six denominations of Ugandan Banknotes (URN, 2021).

Being a person with blindness, Moses was exposed to a number of Banknote identification related challenges that motivated him into this innovation. Some of these challenges included being denied access to ATM card and Cente Mobile by a Ugandan bank due to inability to distinguish Banknote s, starting up a shop but still cannot return proper balance without sighted aid. The worse of all was when a “bodaboda man” gave him a note of UGX2000 and claimed it was a note of UGX3000, a thing which prompted Moses to creatively find a workable solution to Banknote identification challenge. The advantage that Ugandan Banknotes come in six denominations, with subtle differences in width and height that are hard to notice with the naked eye was exploited to invent the identifier. Moses first attempted to remedy this by molding the cover of a spring file and forming tactile denomination identifying lines. Nevertheless, the lines were quite thin and difficult to touch. In order to create a more efficient gadget, a 3D printing method was initiated (Business Times, 2023).

At least forty people with visual impairment in Uganda have utilized the equipment as of right now. Nevertheless, not much is known about its efficacy, and not many people are aware that it even exists. This novel invention is still in its exploratory phase and will need a great deal of research, development, and promotion. Even though some people have profited from it, more people need to know about it and validate it in order to fully understand it's potential (MoLGSD, 2020).

1.2 Statement of the problem

The efficacy of the non-digital Ugandan Banknote identifier as an alternative means to identify the Banknotes for people with blindness in Uganda needed to be ascertained from the users through an experiment and in-depth interviews. This research is due to the fact that people with blindness can operate effectively within the society as it currently exists with the availability and modifications of the tools used for participation in economic and entrepreneur environment. Economic activities and enterprise in Uganda are made possible using Banknotes and coin currencies. Creating a provision for persons who are blind to identify Banknote is a highly beneficial move in promoting inclusion to entrepreneurship and economic independence that promotes transaction convenience for persons who are blind (Mutebile, 2010).

The Ugandan Banknote identifier was innovated with the expectation of solving challenges of Banknote identification faced by persons who are blind However, it has not taken shape in terms of mass production, circulation, usage and improvement raising concerns about its efficacy and yet it is a game changer for persons who are blind for their transition in to the world of business as well as

financial inclusion. This has still not resolved the challenges they encounter during identifying Ugandan Banknotes prompting me to concentrate this study on the efficacy of the Non-Digital Ugandan Banknote Identifier so as to inform its progress.

1.3 Purpose of the Study

This study investigated the efficacy of the non-digital Ugandan Banknote Identifier with focus on accuracy, user-friendliness and any need for modification.

1.4 Specific objectives of the Study

This study was guided by the following objectives;

i. To investigate the accuracy of the non-digital Banknote identifier.
ii. To assess the user-friendliness of the none-digital Banknote identifier for persons who are blind.
iii. To determine the modifications that are needed on the non-digital Banknote identifier for persons who are blind.

1.5 Research questions

The study was guided by the following research questions in relation to the objectives

i. What is the accuracy level of the non-digital Banknote identifier?
ii. How easily can persons who are blind use the non-digital Ugandan Banknote identifier?
iii. What modification should be made on the non-digital Banknote identifier to make it more user-friendly to persons who are blind?

1.6 Scope of the study

1.6.1 Geographical scope

The study was conducted in Lira city where persons who are blind have experience or used non-digital Banknote identifier. Lira has the largest number of people who have used the innovation; organized association with a business that exposes them to money daily. Therefore, participants of the study were persons who are blind who used the Banknote identifier living in the city.

1.6.2 Content scope

The study was limited to investigating the efficacy of the non-digital Ugandan Banknote Identifier. No other impairment. It focused on accuracy of use, user-friendliness and opportunities for modification.

1.6.3 Time scope

This study was conducted over a period of four months, during the final semester of the academic year.

1.7 Significance of the study

1. The inventers of non-digital Banknote identifier will be able to improve its usability for people who are blind by using input from actual users and this will offer insightful information.
2. The study will benefit persons who are blind as it will provide user friendly non-digital Banknote identifier.
3. Through the study findings and recommendations, the country will be fulfilling the SDG 08 about decent work and economic growth especially focusing on financial literacy and economic empowerment they will be also

beneficial in easing the financial transactions of persons who are blind especially when the study recommendations are implemented.

4. The study will promote financial inclusion of persons who are blind by strengthening a Banknote identification system that makes possible their direct involvement in business activities.

   Serve as source of literature on financial literacy amongst persons who are blind for further researchers

1.8 Research Model

A model is a framework that researchers use in order to organize their work and determine how best to address a particular research subject. It aids in clarifying the goal of the study and creating a well-informed viewpoint. This research made use of the social model, commonly referred to as the "barriers-approach." The social model serves as a "route map," outlining the obstacles that people who are blind face while trying to identify Banknotes and how to overcome, lessen, or circumvent these obstacles by employing a non-digital Banknote identifier (Buffa, 2023).

1.9 Theoretical Framework of the study

The study has been guided by the Technology Acceptance Theory, which was developed by Davis in 1989. This theory has its roots in the ideas of Reasoned Action and Planned Behavior. It explains the factors that influence the adoption of information systems. According to this theory, users' intention to use a technology is determined by their perception of its usefulness for a task and its perceived ease of use. These factors predict whether individuals will embrace the technology (Marikyan & Papagiannidis, 2023).

The primary aim of studying technology acceptance was to understand the mechanisms behind technology adoption, offering theoretical support for its effective use. Practically, it aimed to guide practitioners on necessary precautions before system implementation. To achieve these goals, several measures were undertaken. Davis developed the technology acceptance model, which outlines the mechanisms linking the characteristics of information systems (external factors) to actual system usage, providing a framework for understanding how and why users embrace new technologies (Venkatesh & Davis, 2000).

The second phase involved identifying, defining, and validating measures strongly correlated with system usage. Multiple studies were conducted to create, pre-test, and validate multi-item measures for perceived usefulness and ease of use, drawing on prior empirical research on human behavior and information system management. Building on findings from earlier studies (such as Johnson & Payne, 1985; Payne, 1982; Robey, 1979), it was hypothesized that these two constructs were fundamental determinants of user acceptance (Davis, 1989).

Research indicates that an individual's decision to engage in a behavior is influenced by evaluating the expected benefits against the associated costs and efforts (Johnson & Payne, 1985; Payne, 1982). This suggests that the use of an information system is determined by assessing the trade-off between its perceived usefulness and the perceived complexity of its use (Davis, 1989). According to Davis (1989, 1993), technology acceptance occurs in three stages: external factors (such as system design features) elicit cognitive responses (perceived usefulness and ease of use), which then form an effective response (attitude toward using the technology/intention), ultimately influencing usage behavior.

The technology adoption model illustrates behavior as influenced by perceived utility, perceived ease of use, and behavioral intention. Perceived utility and ease of use indicate the belief that the behavior will require minimal effort and lead to positive outcomes (Davis, 1989). In a later study Ajzen, (2011) suggested that instead of focusing on behavioral intention, an affective assessment of the potential outcomes, known as the attitude toward the behavior, could be used (Davis, 1993). The likelihood of a behavior occurring rises with positive emotional response. Perceived usefulness can directly influence actual use, highlighting its importance in predicting behavior. While perceived ease of use has a minimal direct impact on behavior, it supports perceived usefulness (Davis, 1993). According to this concept, the easier an application is to use, the more likely users will find it beneficial, increasing the probability of technology adoption (Davis, 1989; Davis, 1993).

The development of the technology adoption model and its metrics has significantly advanced both theoretical understanding and practical application. Utilizing the information system usability testing model has enabled the evaluation of users' motivation to adopt various technologies, an achievement that was previously impossible due to the absence of reliable subjective measures (Taherdoost, 2018).

Applications

The theory of technology acceptance has been widely applied across diverse fields, settings, and regions, serving as a valuable tool for predicting user behavior. Beyond information systems management, technology acceptance models have also been utilized in marketing and advertising (Ala’a & Ramayah,

2023). The Technology Acceptance Model (TAM) has become a valuable tool for analyzing consumer attitudes toward technologies such as chat bots, e-commerce platforms, and online shopping tools, which are integral to online trading. This is largely due to the widespread adoption of information systems in product and service marketing (Salmassi et al., 2022). For example, TAM was used to investigate customer evaluations of online shopping features, influencing their decision to make purchases through e-commerce platforms. The study found that, along with trust, the components of TAM significantly explain the variation in attitudes toward information system tools and subsequent customer behavior (Granic, 2022).

Researchers have explored the acceptance of various technologies, including virtual reality, mobile banking, telecommunications, and e-learning platforms, testing technology acceptance models in different contexts (Lee et al., 2011). The findings showed that while the impact of ease of use was inconsistent, perceived usefulness was consistently significant across all types of technology. For instance, for the adoption of text-mining technologies, it was essential that users found the software both practical and easy to use (Demoulin & Coussement, 2020). Mathieson, (1991), discovered that the constructs of the Technology Acceptance Model had a significant influence on behavioral intention when evaluating the acceptance of the World Wide Web.

The predictive power of the Technology Acceptance Model (TAM) has been evaluated in various cultural and geographical contexts, including the United States, Japan, India, and the Netherlands (Singh et al., 2020). Studies found that TAM effectively explains why websites are accepted and used in both the

Netherlands (Heijden, 2003) and India (Singh et al., 2020). From a practical perspective, TAM helps suppliers estimate potential demand or stock quantities for new IT products (Davis, 1989). Practitioners can use TAM to facilitate technology adoption by creating IT products that consumers find useful and easy to use (Davis, 1989).

Application of the Theory in Relation to study

This study investigated the efficacy of the non-digital Banknote identifier, focusing on its accuracy, ease of use, and potential for improvement. It aimed to understand the behavior of people who are unaware of this innovation. Additionally, the research explored the perspectives of persons who are blind regarding the effectiveness of the non-digital Banknote identifier.

The main focus of this study was on the behavior and perspectives of individuals who are familiar with non-digital Banknote identifier. This directly relates to the core objective of the Technology Acceptance Theory, which aims to explain the mechanisms facilitating technology adoption, predict its behavior, and provide a theoretical basis for its effective application. The study is guided by the premise of the Technology Acceptance Model, which posits that behavioral intention of users is influenced by their assessment of the usefulness of technology and ease of use which plays an essential role in adoption (Chen et al., 2011).

Limitations

Technology Acceptance Theory has been criticized and shown to have several shortcomings over time. The simplicity and narrow comprehension by the theory of the variables driving technology adoption, such as perceived utility and perceived ease of use, have drawn criticism (Marikyan & Papagiannidis, 2023).

Because of criticisms that the original Technology Acceptance Model (TAM) was unduly rigid, academics have been looking into other concepts that can improve the ability of the model to predict outcomes. As a result of these initiatives, the model now includes variables such as compatibility, relevance, subjective norms, technology fit, trust, and compatibility (Ajibade , 2018).

Venkatesh et al., (2007) are among the critics who have suggested that the extensive use of TAM in information system research may have given the impression of advancement. They contend that a lot of research has only repeated earlier discoveries, which has slowed down advancements in the area. There are blind areas in the literature as a result of this widespread use. One example of a blind spot is the focus TAM has on understanding the reasons for people's technology adoption, sometimes overlooking the wider effects of technology use on performance (Goodhue, 2007). In actuality, the notion that using technology more often inevitably results in better performance is not always accurate.

Critics have also drawn attention to TAM's weak focus on what truly distinguishes a useful system from others: the system's architecture and how well it fits users' tasks. This is a critical component for both the adoption of technology and attaining optimal performance from its application (Benbasat & Barki, 2007; Goodhue, 2007). Consequently, a rising body of research suggests that TAM may be at the end of its useful life and that the likelihood of seeing the model replicated in the future without significant theoretical advances is low (Benbasat & Barki, 2007; Venkatesh et al., 2007).

Technology Acceptance Theory criticism draws attention to methodological flaws, application limitations, and an overemphasis on system utilization aspects

that have obscured other important variables and relationships (Venkatesh & Davis, 2000; Goodhue, 2007; Benbasat & Barki, 2007 (Venkatesh et al., Thong, & Xu, 2012). The theory continues to make important contributions even in the face of these criticisms. In evaluating intentions of people in using technology, the Technology Acceptance Model (TAM) has proven to have significant predictive power and theoretical soundness over the course of almost three decades. According to Goodhue, (2007), TAM was the first theory to address the critical need to explain why people use information systems. As a result, it has made significant contributions to information systems research as well as practical implementations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter examined the literature review of the study. The main goal is to review the literature on the Ugandan Banknote identification system for persons who are blind. This literature evaluation is essential since it will provide information about the applicability and relevance of the study.

2.1 How Persons who are blind Identify Banknotes

Venkatesh et al., (2003) highlights how important it is for people who are blind to be able to quickly and safely identify paper money, especially when making or receiving change. There are several options based on the currency. Let us examine a few techniques that help people who are blind safely identify their paper money.

2.1.1. Tactile Features on Banknotes

According to Kyrychok, (2018) a large number of nations, including Canada, Bahrain, Thailand, Malawi, and Hong Kong, have added tactile elements to their Banknotes to make them easier for people who are blind to handle. People who are blind can tell what denomination they are holding thanks to these tactile elements, which are frequently found in the corners of the notes. For example, to improve recognition, Brazilian cash combines different sizes for each denomination with tactile characteristics, whereas Chilean currency uses high contrast colors.

However, records from Bank of Uganda (BOU) indicate that the majority of the alterations made to Ugandan Banknotes have been to images of non-tactile

objects and portraits of leaders. For example, Banknotes featuring image of President Idi Amin were first introduced in 1971 during the regime of Idi Amin. After the government changed in 1979, the portrait of Amin was replaced with an artistic representation of the Bank of Uganda building, but this feature did not offer tactile identification for people who are blind. In 1982, new currency was issued after to a change in administration in 1980. The portrait of President Milton Obote featured on new 500- and 1000-Shilling notes, while the existing denominations were retained. But those who are blind or visually impaired could not reach these Banknotes (Business Times, 2023).

A new series of currency was introduced in 1985/86 following yet another change in government in 1985. In this series, the National Emblem was used in place of the portrait of president Obote, with the map of Uganda serving as the background. In addition to the current 1000- and 5000-Shilling currency denominations, a new 5000-Shilling Banknote was also introduced at the same time as this change. The Bank of Uganda introduced a new series of 1000-shilling Banknotes on December 10, 2001. Improved security measures on these redesigned Banknotes were intended to discourage counterfeiters. One of these features was a security thread that was embedded vertically and had the number 1000 clearly displayed throughout its length. The year 2000 and a hidden picture of the number 1000 in the bottom center were also printed on the Banknotes. Through these developments, users and other stakeholders in the financial system should feel more confident in the security and legitimacy of the currency (BoU, 2020).

The Bank of Uganda improved the 1000-Shilling notes even further on June 20, 2005. These included using shifting ink technology and switching to more

durable cotton paper. Remarkably, the lower left front numeral 1000 was intended to enhance security features by changing from green to blue depending on the angle from which it was viewed. Notwithstanding these security improvements, the Banknotes' lack of tactile characteristics prevented them from being easily recognized by touch, which raised accessibility issues for people who are blind (BoU, 2020).

2.1.2. Digital Banknote identification solutions

Venkatesh et al., (2003) investigated a number of technology options meant to increase the ability of people who are blind to acquire Banknotes. These inventions include tools which include Quinita Noronha and Sepvina Mutikasari Money Decoder and the US Bureau of Engraving and Printing Money Identifier. These solutions solve a major accessibility challenge that blind populations around the world face by helping visually impaired people recognize and distinguish Banknotes using tactile or aural feedback.

To detect Banknotes and audibly declare their denomination, other software apps have been developed, including the US Bureau of Engraving and Printing's Eye Note TM, Look Tel Money Reader for iPhone, iPod Touch, and Mac, and Cash Reader for iOS and Android. However, due to low digital literacy among blind people, the adoption of these digital money IDs and mobile applications is restricted in Uganda. Moreover, considering the financial situation of many people who are blind in Uganda, the majority of these gadgets and apps are unaffordable for them because they are mostly made for foreign currencies (Kasthuri & Kesavan, 2023).

2.2 Solutions Persons who are blind invented to identify Banknotes

People who are blind have devised innovative solutions to quickly identify Banknote s, even in the absence of tactile markings. These solutions include using specially designed apps that utilize a smartphone camera to detect and announce the value of the Banknote , as well as employing portable electronic devices that scan and identify the currency, ensuring independence and ease in financial transactions (Alamirew & Kebede, 2024).

2.2.1 Identifying by folding Money

People who are blind frequently need assistance in order to initially recognize the denominations of currency. According to Dunai et al., (2017) a sighted person can assist in organizing money so that it can be identified in the future. Through this method, money is folded in various ways that the person who is blind can thereafter independently recognize. For this approach to be successful, trust in the sighted assistant is essential. Simple yet efficient methods include folding $5 notes widthwise, folding a $10 bill lengthwise, and leaving a $1 bill unfolded. For larger denominations, combinations of these folding patterns can be employed, offering a workable method for prompt denomination recognition.

2.2.2 A wallet with dividers

Those who are blind can organize and make access easier for themselves by dividing each denomination into a different portion of a wallet with four or five compartments. Although largely successful, this approach can be difficult for people who are blind to handle several denominations, which could cause confusion. It also becomes unfeasible when people have to carry several denominations of Banknotes and currencies at the same time since it gets difficult

and less effective to separate them into separate wallet compartments (Paisios, 2012).

2.2.3 Braille on Banknotes

Banknotes with braille play a vital practical role for blind people, because it can be difficult to tell one denomination from another without it. To help people who are blind and visually challenged, several nations have implemented braille features. For example, Banknotes in Canada have braille dots instead of numbers. In a similar vein, Australia utilizes braille dots, but Honduras uses genuine braille digits, so people who are blind handling Banknotes may easily identify themselves (Hartono & Cahaya, 2017).

Other tactile features of Banknotes

Although adding braille to Banknotes would be advantageous, there is a big obstacle: a large number of people who are blind are unable to read braille. In the US, barely 12 percent of school-age students study braille, according to the National Braille Press. Therefore, tactile elements such as braille dots, lines, or forms are important, even when braille numerals might not be. Differentiating between currencies becomes challenging if one is not braille literate; for example, the $2 and $5 bills have the same amount of dots. Moreover, minute variations in dot patterns might be more confounding than useful, particularly on worn notes. Different Banknote denominations have different widths, textures, and lengths, which are alternative ways to improve accessibility (Kana & Hagos, 2024).

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The chapter presents the methodology employed in this study, detailing the framework for research design, study population, geographical area, sample size determination, sampling techniques, and data collection methods. It encompasses the use of validity and reliability instruments, ethical considerations governing participant involvement, and methodological limitations. The primary focus of the study is to investigate the efficacy of the non-digital Ugandan Banknote identifier

3.2 Research Design

The structure for collecting, evaluating, interpreting, and sharing data is provided by a research design (Myers, 2008). In order to collect data for this study in an objective and controlled manner, maximize precision, and make specific conclusions about hypotheses, an experimental research design has been adopted. Finding the effect of an independent variable the Banknote identifier on a dependent variable was the main goal.

The study employed an experimental design comprising an experimental group using the Banknote identification and a control group without it. Both groups were tasked with identifying Banknote s, providing valuable insights into how individuals who are blind perceive the non-digital Ugandan Banknote identification. This design allowed for a comparative analysis between those using the identification tool and those relying on traditional methods, aiming to

assess the efficacy of the Banknote identifier among persons with blindness (Sousa, et al., 2020).

To generate thorough insights, a triangulation approach was used which allowed for combining quantitative and qualitative methodologies. In-depth interviews were used in qualitative research to explore the perspective of people who are blind on the Banknote identification. The purpose of these interviews was to reveal complex viewpoints and experiences. In the meantime, quantifiable data on observable behaviors connected to Banknote identification was gathered by quantitative approaches. Following a thorough statistical analysis, this data was used to gain a better understanding of how people who are blind interact with and perceive the non-digital Ugandan Banknote identification (Carter et al., 2014).

3.3 Study Area

Willie, (2024) asserts that the entire jurisdiction, in which research is conducted, including specific localities within it, is included in the study area. The focal point of this study was Lira City in northern Uganda, where people who are blind have used or are familiar with non-digital Banknote identifier. Lira City was chosen due to the huge number of people with blindness living there who have used these innovations. This guaranteed accurate data collected in line with the goals and subject matter of the study.

3.4 Study Population

The study population which is also known as the universe comprises all individuals, events, or objects that constitute the specific group from which a researcher aims to gather data. In this study, the primary focus was on over 40 persons with blindness residing in Lira City. These individuals have experienced

the non-digital Banknote identifiers and directly responded to the inquiries of the study, being the central subjects of interest (Shukla, 2020).

3.5 Sampling size and procedures

3.5.1 Sample Size

As pert the study population size, a sample was selected to represent the opinions of all participants. From the population of forty individuals, a total sample size of twenty was chosen. The determination of this sample size followed the guidelines provided by Krejcie and Morgan (1970), which offers a standardized approach for selecting samples relative to the population size. The distribution of the sample selection adhered to the specifications outlined in the table below (Mohapatra & Chamola, 2020).

Table 3.1: Sample Size

Sample Category	**Study population**	**Sample size**	**Sampling technique**
Persons who are blind	40	20	Purposive sampling
Total		20	

Source: Filed Data, (2023)

3.6 Data Collection Methods

The process of collecting data entails learning more about a subject. While collecting data for this project, interviews and experimental methods were used.

3.6.1 Experimental Method

An experiment involves changing one or more factors in order to observe how these changes impact other aspects of the subject or participants. Social science experiments are conducted to understand how these changes affect a sample of the population. To assess the ability of respondents to accurately identify Banknotes using an identifier, the researcher conducted an experiment with two groups: the experimental group who used the identifier to identify Banknote s, and the control group identified Banknotes without using the identifier. A total of 10 persons who are blind participated in the experiment. Their blindness was verified with information from the Union office and direct observation. The two groups were equally distributed through random selection and seated at two different tables. During the experiment the experimental group was given the identifier and Banknotes while the control group was only given the Banknotes to identify without seeking sighted help and had to declare the amounts identified loudly as the guides available help to confirm. The researcher paid close attention to how people who are blind utilized the Banknote identifier to recognize the notes. Feedback was then received following the experiment.

3.5.2 Sampling Techniques

In this study both convenient and purposive sampling techniques were utilized. As described by Etikan, (2016) convenient sampling involves selecting participants based on their availability and willingness to participate, allowing them the freedom to decide whether to take part in the study. Conversely, purposive sampling allows researchers to select volunteers based on predetermined criteria such as experience, interest, and knowledge. This

approach was employed in gathering data from individuals who are blind in Lira City.

3.6.3 Interview Method

Interviews are designed to gather additional information, clarify responses, and capture the facial expressions of respondents. This method aims to delve into thoughts of participants and emotions through direct interaction and verbal inquiry. For the study in Lira City, semi-structured interviews were conducted with a chosen group of persons who are blind to gather data effectively (Alshenqeeti, 2014).

3.7 Data Collection instruments

There was use of a semi-structured interview guide to collect data for this study. Using prearranged schedules to meet important respondents at predetermined sites throughout Lira City, this method entails conducting in-depth interviews with them. Twenty interviews with people who are blind in Lira City was scheduled, and the interview guide helped collect data that is in line with the objectives of the study (Ruslin et al., 2022).

3.8 Research procedure

The researcher obtained an introduction letter from Kyambogo University to start the research procedure. It was photocopied and sent to the appropriate offices to request authorization to carry out the study. Selected respondents received this letter outlining the objectives of the study. Two participant groups were created for the experiment, and then in-depth interviews utilizing the interview guide was carried out.

3.9 Data Analysis

Rahman & Muktadir, (2021) asserts that data analysis is the process of finding patterns in objects or recurrent behaviors within a body of knowledge. The gathered information was analyzed in the following ways: every instrument was carefully examined, notes were made, and categories that emerge from the data were grouped together. After that, these categories were determined and noted, ensuring that the data collected were in line with each one. By grouping related categories together, emerging themes were found, and observations and theories were compared with the qualitative data. The results are displayed in a discursive and tabular manner.

3.10 Ethical considerations

Permission was sought from the appropriate authorities in the area of study before beginning data collection. There was no compulsion or manipulation of respondents during interviews as data collecting is done impartially and objectively. Strict confidentiality was upheld, along with participant identity preservation and the values of honesty and integrity in the management of primary and secondary data.

3.11 Limitations of the study

The substantial travel needed for data gathering resulted in financial difficulties, but these were lessened with the help of friends and family and personal savings. Participant rigidity almost made it difficult to collect accurate data. Time restrictions in addition to other obligations made it difficult to finish the study in the allotted amount of time.

3.12 Summary

There is assurance that the goals of the study will be fully attained because of the variety of approaches used. In addition to achieving its present objectives, this research stimulates and motivates additional investigation by other specialists in the domain. It seeks to deepen awareness and make a broader contribution to the topic by promoting further research.

CHAPTER FOUR

DATA PRESENTATION, INTERPRETATION AND ANALYSIS

4.1 Introduction

This chapter presents the study results on the efficacy of the non-digital Ugandan Banknote identifier. The findings are organized around three main objectives: evaluating the accuracy of the non-digital Banknote identifier, assessing its user-friendliness for persons who are blind, and identifying any necessary modifications to improve the non-digital Banknote identifier.

4.2 Response rate of the respondents

Twenty Semi-structured interviews were to be conducted; however, 18 interviews were conducted with relevant information for the study. This constituted 90% response rate which enabled me to obtain reliable information for the study. The two interviews were not conducted due to abrupt change in schedule of respondents given their work demand and family obligations. The responses are summarized in the Table below.

Table 4. 1: The response rate of the respondents

Tool/Instrument	**Planned (n)**	**Actual (n)**	**Not conducted (n)**	**Percentage (%)**
Interviews	20	18	02	90%

Source: Field Data (2023)

The results shown in Table 2 indicate a 90% response rate, suggesting a strong representation of the survey population. This aligns with (Amin, 2005), who

states that, a response rate of 50% or higher is indicative of a well-represented survey population.

4.2.1 Socio-Demographic Characteristics of the Respondents

This constituted; gender, age, and educational level of the respondents.

Gender of the respondents

Under this variable, the study sought to establish the gender of the respondents and the findings were as follows.

Table 4. 2: Gender of the respondents

Gender	Persons who are blind	Percentage
Male	12	66.7
Female	06	33.3
Total	18	100

Source: Primary Data, (2023)

As shown in the table, 66.7% of the respondents were male and 33.3% were female. This demonstrates that the study included participants of both genders, reflecting gender sensitivity. By obtaining information from both males and females, the study was able to enrich its findings with diverse perspectives on the matter under investigation.

Age Range

The study considered the age of the respondents to be an important factor, so it investigated their age range. The findings are summarized in Table 4 below.

Table 4. 3: The distribution of respondents by Age

Age Range (in years)	Persons who are blind	Percentage
18 – 22	00	00
23 – 25	01	5.5
29 – 34	03	16.7
35 – above	14	77.8
Total	18	100

Source: Field Research 2023

The statistics in Table 4 indicate that the majority of respondents (77.8%) were aged 35 and above, followed by 24.1% in the 29-34 age range, and 5.5% in the 23-25 age range. Valuable insights were gathered from all age groups, as they were respondents with blindness, whose contributions were crucial to the study. Consequently, each age bracket provided significant information for the research.

Distribution of respondents by Level of Education

The study involved respondents with varying levels of education. The results are summarized in Table 4.4 below;

Table 4. 4: Distribution of respondents by Level of Education

Age Range (in years)	Persons with visual impairment	Percentage
Primary	03	16.7
Secondary	07	38.9
Tertiary	07	38.9
University	01	5.5
Total	18	100

Source: Primary Data (2023)

The data in Table 4 reveals that 38.9% of respondents had completed secondary education and also attained tertiary education, while 16.7% had stopped at the

primary level. 5.5% of respondents had achieved a university education and held bachelor's degrees. This high level of education among respondents supports the conclusion of the study which held that there is a significant degree of enlightenment within the group, enhancing confidence in the reliability of the information obtained.

4.3 Accuracy of the non-digital Banknote identifier

This was the first objective of the study which investigated the accuracy level of the non-digital Banknote identifier. The findings were summarized in table 5 in percentage.

Table 4. 5: Responses on the accuracy of the non-digital Banknote identifier

Statement	Yes		No	
	Frequency	**Percent**	**Frequency**	**Percent**
I. Have you ever used the non-digital Banknote identifier?	18	100	00	00
ii. While using the non-Banknote identifier, were you able to identify the exact Banknotes at hand by then?	16	88.9	02	11.1

Source: Field Data (2023)

The study findings as shown in table 6 above showed that all that 18 respondents (100%) admitted to have ever used the non-digital Banknote identifier. This meant that all the respondents involved in the study had an experience with the non-Banknote identifier thus giving information about the accuracy of device out of direct experience.

When the study respondents were asked about the accuracy of the non-digital Banknote identifier, the results were summarized in table 6 above. The study

found out that 16 (88.9%) respondents stated that the non-digital Banknote identifier was an accurate device to detect Banknotes of various denominations. However, 02 (11.1%) respondents stated that non-digital Banknote identifier was not accurate and they could not rely on it to determine the various Banknote denominations. They could seek for help from friends or relatives, and sometimes they could determine the Banknotes by feeling them, and by their size.

Majority of the respondents interviewed remarked that;

"……before the invention of the non-digital Banknote identifier, they were primarily using what respondent said local approaches or methods in determining the Banknotes. They stated that they were relying on the sight of neighbors, friends or relatives to determine Banknote denominations, of which some of them were not trustworthy. That is, they could tell them different values from the actual ones on the Banknotes thus cheating them. Other interviewed respondents stated that they could determine the Banknotes denominations using their size. They stated that though they always handle money, it was always very difficult to determine Banknote denominations due to untruthful of some friends, relative they sought help from, and also lack of accuracy in using Banknote size to determine its denomination.

However, most of the interviewed respondents affirmed that the non-digital Banknote identifier has made it easy for them to identify Banknotes denominations with high level of accuracy. They stated that the invented device has come to their rescue and it easy there day to day monetary transactions thus boosting their businesses, work and livelihood".

The study findings from direct interaction or interview with respondents indicated that most respondents do often handle money and the non-digital Banknotes identifier has tremendously help them to identify the denominations of various Banknotes. This has made them gain self-reliance in their daily financial transactions.

4.4 User-friendliness of the non-digital Banknote identifier for persons who are blind

The study investigated the user-friendliness of the non-digital Banknote identifier for persons who are blind. Under this objective, the study investigated on how long the respondents took learning how to use the non-digital Banknote identifier, the result was stated in table 7 below.

Table 4. 6: User-friendliness of the non- digital Banknote identifier for persons who are blind

Statement	**Days**	**Frequency**	**Percent**
How long did you take learning how to use the non-digital Banknote identifier?	1 -7	16	88.8
	8 – 14	01	5.6
	15 – 21	00	00
	22 - 30	01	5.6
	Total	18	100

Source: Field Research 2023

The results in table 7 above show that most of the respondents learnt how to use the non-digital Banknote identifier within a period of between one to seven days (a week's time). This is indicated by 16 (88.8%) respondents who stated that they learnt how to use the device between one to seven days. Some respondent took more than a week to learn how to use the device; 01 (5.6%) respondent stated that

he spent two weeks learning how to use the device, and another 01 (5.6%) respondent stated that she took one month learning how to use the non-digital Banknote identifier.

This finding shows that persons who are blind can easily learn how to use non-digital Banknote identifier within a short period of time. This therefore makes the non-digital Banknote identifier easy to use thus very user-friendly to persons who are blind in their daily monetary transactions.

In investigating the user-friendliness of the non-digital Banknote identifier, the study examined the challenges that are hindering effective use of the device. The feedback was summarized in table 4.7 below.

Table 4. 7: Challenges faced by persons who are blind while using non-digital Banknote identifier

Challenge statement	**Frequency**	**Percent**
Delay in identifying Banknotes especially bulky notes	10	55.6
Difficulties in fixing Banknotes into the device especially old weak notes	12	66.7
Device cannot detect fake notes	07	38.9
Weak material and very small	05	27.8

Source: Field Research 2023

According to the study findings in table 8 above, majority of the respondents 12 out of 18 (66.7%) stated that difficulties in fixing Banknotes into the Banknote identifier especially old and weak Banknotes is a main challenge they face while using the non-digital Banknote identifier. The second frequently stated challenge was delay or slowness in identifying Banknotes especially when there is a lot of

Banknotes to be identified and counted. The delay is also attributed to old and weak notes that take much time in the process of fixing them into the Banknote identifier. The other challenges were, the device cannot detect fake notes as stated by 07 (38.9%) respondents and the device is made out of weak material and very small lines as stated by 05 (27.8) respondents.

This study finding affirms that the users of non-digital Banknote identifier face various challenges, and therefore to make the device more user-friendly the stated challenges have to be resolved in the modification of the device.

However, besides the challenges encountered while using the device, based on the study findings, the study concludes that it is easy to learn how to use the non-digital Banknote identifier and this make it very user-friendly to persons who are blind.

4.5 Modifications needed on the non-digital Banknote identifier for persons who are blind

Under this third objective of the study, the study investigated the modifications needed on the non-digital Banknote identifier to make them more user-friendly for persons who are blind. The findings were summarized as expressed in the table 9 below.

Table 4. 8: Modifications needed on the non-digital Banknote identifier for persons who are blind

Modification needed	Frequency	Percent
Use wood or plastic material instead of the current material	07	38.9
Increase on the size and lines of the non-digital Banknote identifier	05	27.8
Provision for fixing money be put on side of the device	02	11.1
Talking aspect included in the device	03	16.7

Source: Field Research 2023

Table 9 above indicates that 07 (38.9%) of the respondents stated that wood, metal, rubber or strong plastic materials should be used in making the non-digital Banknote identifier instead of the current material. 05 (27.8%) respondents stated that there is need to increase on the size and lines of the non-digital Banknote identifier. 03 (16.7%) of the respondents stated that there is need for modification to be made that will include the talking aspect in the device so as mentions the denominations of the Banknotes. Lastly, 02 (11.1%) of the respondents stated that it would be better if the provision for fixing money be put on the sides of the device.

The study findings as presented in table 9 above indicates that their modifications to be made on the non-digital Banknote identifier so as to make it more user-friendly to persons who are blind in the process of identifying Banknote denominations.

The study gave a group of five persons who are blind to identify Banknotes without the non-digital Banknote identifier. The feedback obtained was summarized in the table below;

Table 4. 9: Showing the feedback from group of respondents given to identify Banknotes without non-digital Banknote identifier

Description	**Number**	**Feedback**
Identified the Banknote s	01	- Partially blind, could see figures though with difficulties
Failed to identify Banknote s	04	- Could not identify the Banknotes values due to inability to differentiate their size, color, note texture among other features. - The Banknotes had no any tactile features to enable people who are blind to identify them.
Total	**10**	

From the findings summarized in table 10 above, the study found out that out of a group of five persons who are blind who were given Banknotes to identify without using non-digital Banknote identifier, only one person was able to identify the Banknote s, whereas four persons found difficulties and at the end were unable to identify Banknotes. Thus, the study concluded that persons who are blind cannot identify Banknotes by themselves without the help of any Banknote identifier device thus they always need help from someone else who is sighted.

4.6 Conclusion

This chapter has categorically presented the study data and findings. The chapter has presented the socio-demographic characteristics of respondents, accuracy of the non-digital Banknote identifier, user-friendliness of the non-digital Banknote identifier for persons who are blind and various modifications necessary on the non-digital Banknote identifier for persons who are blind. The findings presented in this chapter are summarized and discussed in chapter five of the study.

CHAPTER FIVE

DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The interest of the researcher in this chapter five is to discuss the study results, conclusions and recommendations in relation to the perception of Persons who are blind on the use of Non-Digital Ugandan Banknote Identifier. The study based its findings on a sample of 18 respondents with blindness. This chapter provides the summery of the findings, discussion, conclusion and recommendations based on the study's objectives:

i. To investigate the accuracy of the non-digital Banknote identifier.
ii. To assess the user-friendliness of the non-digital Banknote identifier for persons who are blind.
iii. To determine the modifications that is needed on the non-digital Banknote identifier for persons who are blind.

The study addressed several key questions through semi-structured interviews to achieve its objectives: assessing the accuracy of the non-digital Banknote identifier, evaluating its user-friendliness among persons with blindness, and identifying necessary modifications to enhance its usability. Findings from these inquiries are organized in accordance with the objectives of the study. Following the discussion, this chapter also provides conclusions, recommendations, and proposals for further research based on the identified areas of improvement.

5.2 Discussion

Accuracy level of the non-digital Banknote identifier

The findings from table 6 indicate that all 18 respondents (100%) in the study reported having used the non-digital Banknote identifier, demonstrating a universal experience with the device among participants. When questioned about its accuracy, 88.9% (16 respondents) affirmed that the non-digital Banknote identifier accurately detects Banknotes of various denominations. However, 11.1% (2 respondents) expressed doubts about its accuracy, preferring to rely on assistance from others or tactile methods such as feeling the Banknotes or judging by their size.

These findings underscore that while the non-digital Banknote identifier generally proves accurate in identifying Banknote denominations, there is room for improvement, as suggested by respondents and outlined in the recommendations. Methods such as relying on touch, assistance from others, or estimating by size lack the certainty and accuracy provided by the non-digital Banknote identifier. Its introduction has significantly increased the reliability and precision in Banknote identification for persons with blindness, highlighting its pivotal role in facilitating independence in financial transactions.

Majority of the respondents interviewed remarked that;

"……before the invention of the non-digital Banknote identifier, they were primarily using what respondent said local approaches or methods in determining the Banknotes. They stated that they were relying on the sight of neighbors, friends or relatives to determine Banknote denominations, of which some of them were not trustworthy. That is, they could tell them different values

from the actual ones on the Banknotes thus cheating them. Other interviewed respondents stated that they could some time determine the Banknotes denominations by comparing their sizes. They stated that though they always handle money, it was always very difficult to determine Banknote denominations due to untruthful of some friends, relative they sought help from, and also lack of accuracy in using Banknote size to determine its denomination.

However, most of the interviewed respondents affirmed that the non-digital Banknote identifier has made it easy for them to identify Banknotes denominations with high level of accuracy. They stated that the invented device has come to their rescue and it easy there day to day monetary transactions thus boosting their businesses, work and livelihood".

The findings, based on direct interactions and interviews with respondents, highlight that many of them frequently handle money, relying significantly on the non-digital Banknote identifier to distinguish various denominations. This device has notably enhanced their independence in managing daily financial transactions.

These findings align with the perspectives shared by (Vivek et al., 2022) who emphasized the importance of effective measures such as tactile features on Banknotes and the development of both digital and non-digital Banknote identifiers. Ensuring persons with blindness can safely and efficiently identify their currency during transactions, whether receiving payment, making purchases, or receiving change is vital for their financial autonomy and security.

User-friendliness of the non-digital Banknote identifier for persons who are blind

This objective focused on assessing the user-friendliness of the non-digital Banknote identifier among persons with blindness. The study revealed that a significant majority, 88.8% (16 respondents), learned how to use the device within a short timeframe ranging from one to seven days. While most respondents quickly adapted to the device, a small percentage took longer: 5.6% (1 respondent) spent two weeks learning, and another 5.6% (1 respondent) took a month. This finding underscores that persons who are blind can readily acquire the skills needed to use the non-digital Banknote identifier, making it highly user-friendly for their daily monetary transactions.

However, the study also identified challenges that hinder the device's user-friendliness for persons with blindness. The most commonly cited issue, noted by 66.7% of respondents (12 out of 18), and there was difficulty in inserting old or weak Banknotes into the device. This challenge contributed to delays in identifying and counting Banknote s, particularly when handling large volumes. Additionally, 38.9% of respondents (7 individuals) mentioned that the device does not detect counterfeit notes, while 27.8% (5 respondents) expressed concerns about the device's durability and the visibility of its markings. Despite these challenges, the majority of respondents affirmed that the non-digital Banknote identifier significantly assists them in their daily financial transactions, highlighting its overall utility and importance.

Modifications needed on the non-digital Banknote identifier for persons who are blind

Table 9 above indicates several key suggestions from respondents regarding improvements to the non-digital Banknote identifier.

To enhance the non-digital Banknote identifier's user-friendliness for persons with blindness, 38.9% of respondents recommended using more durable materials such as wood, metal, rubber, or strong plastic. Additionally, 27.8% suggested increasing the size and adding lines to the device. Incorporating a talking feature to announce the denominations of the Banknotes was proposed by 16.7% of respondents, while 11.1% recommended adding a provision for fixing money on the sides of the device. These findings indicate that several modifications are necessary to improve the device's usability for persons with blindness.

The findings align with the suggestions made by the National Braille Press (2002), which emphasized the importance of certain modifications to currency to make it more accessible to persons with blindness. For example, in the United States, only 12 percent of school-age children learn braille. Therefore, it is not just the inclusion of braille numbers on Banknotes that is important, but also the addition of tactile features such as braille dots, lines, or shapes, which can greatly enhance usability.

5.3 Conclusions

This study investigated the efficacy of the non-digital Ugandan Banknote identifier. The primary objectives were to assess its accuracy, user-friendliness, and any need for modification.

The first objective examined the accuracy of the non-digital Banknote identifier. The study found that it is an effective tool for correctly determining Banknote denominations. Given that many persons with blindness frequently handle money, this device has significantly aided them in identifying various Banknote s, thereby enhancing their self-reliance in daily financial transactions.

The second objective assessed the user-friendliness of the non-digital Banknote identifier. The findings revealed that persons who are blind can learn to use this device quickly, making it highly user-friendly for their daily monetary activities. However, there is a need to include additional features on the Banknote s, such as braille marks, in addition to size variations, to further facilitate ease of use.

The study also highlighted the necessity of using more durable materials in the production of the non-digital Banknote identifier. Materials such as wood, metal, rubber, and strong plastic are recommended to replace the current material, enhancing the device's durability and usability.

Lastly, the study concluded that persons with blindness often cannot identify Banknotes by themselves, necessitating assistance from sighted individuals or the use of Banknote identifier devices. This underscores the importance of having reliable and user-friendly identification tools to support their financial independence.

5.4 Recommendation

Trust and Confidence in Currency Identification: It is critical for persons who are blind to have reliable means of identifying currency. The study concluded that the non-digital Banknote identifier is an accurate device for determining Banknote denominations. Therefore, there is a significant need to sensitize

persons with blindness about these innovations to help ease their daily living. This awareness will encourage the adoption, acquisition, and use of the non-digital Banknote identifier, addressing the challenges of Banknote identification in routine monetary transactions.

The study found that the non-digital Banknote identifier is user-friendly, primarily due to the variation in Banknote sizes. However, it is recommended to increase on the size of the identification lines to make them more identifiable. These features will facilitate easier identification and financial transactions for persons with blindness, saving time and reducing the risk of being cheated by those they might rely on to tell them the Banknote values.

The study concluded that there is a need for more durable materials in the making of non-digital Banknote identifiers. It is recommended to use strong, portable, and durable materials such as wood, metal, rubber, and strong plastics. These materials will enhance the longevity and reliability of the identifiers.

Respondents also suggested exploring the possibility of inventing digital solutions in addition to the non-digital Banknote identifier for persons who are blind. This innovation could further improve the efficiency and accessibility of currency identification.

5.5 Areas for further study

It is imperative to investigate how adaptive technology affects the life of people who are blind on a social, moral, and economic level, especially in rural locations. To fully grasp the impact of these technologies and pinpoint areas in need of development, a thorough assessment of how they affect different facets of the lives of blind people.

It is strongly advised to look into the creation of distinctive features for Ugandan Banknotes to help people who are blind identify them. In order to improve accessibility and usability and make Banknotes universally useable by people with and without vision, research should concentrate on finding and suggesting improvements that could be introduced.

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APPENDICES

Appendix I: Semi-Structured Interview Guide

Self-introduction of the Researcher

I am **MOSES AYOLI**, a student at Kyambogo University pursuing a master's degree in Special Needs Education. I am undertaking a research study titled "The Perception of persons who are blind on the non-digital Banknote identifier". You have been purposively selected to participate in this study.

All information you provide will be kept confidential and for the purpose of this study only. Your name will not appear in any part of the report

BIO DATA OF RESPONDENTS

i. Age group A. (18 – 22) ☐ B. (23 – 28) ☐

C. (29 – 34) ☐ D. (35 – Above) ☐

ii. Education level of the respondents

A. Primary level ☐ B. Secondary level ☐

C. Tertiary ☐ D. University ☐

ii. Gender of the respondent

i. Male ☐ ii. Female ☐

SECTION A: ACCURACY OF NON-DIGITAL BANKNOTE IDENTIFIER

1. How often do you handle Banknote s?

i. Rarely ☐ ii. Sometimes ☐ iii Always ☐

2. How have you been identifying the different Banknote s

……

……

……

……

Have you ever used the Non-digital Banknote Identifier?

YES ☐ B. NO ☐

3. If yes to 3 above, for how long have you used the Non-digital Banknote Identifier?

……

While using the non-digital Banknote identifier, were you able to identify the exact Banknotes at hand by then?

YES ☐ B. NO ☐

4. I. How many times have you used the device on the following Banknote denominations:

UGX1000, 2000, 5000, 10,000, 20,000 and 50,000.

II. out of the attempts which you have used the device how many times have the device accurately identified these denominations.?

UGX1000, 2000, 5000, 10,000, 20,000 and 50,000.

SECTION B: USER-FRIENDLINESS OF NON-DIGITAL BANKNOTE IDENTIFIER

1. How many days did you take learning how to use the device?

……

……

What challenges have you faced while using the device?

……

……

……

……

Please explain.

2. What do you like about the device?

……

……

……

What is your comment on the features of the device (identification lines, material used, size, the pocket, the balancing space, and structure)?

……

……

Do you think this device can solve the Banknote identification challenge and related issues among persons who are blind in Uganda? Explain.

YES ☐ B. NO ☐

If yes, explain how;……

SECTION C: MODIFICATIONS THAT CAN BE MADE ON THE NON-DIGITAL BANKNOTE IDENTIFIER

1. For purposes of ease of use and convenience, which of the following modifications would you prefer to be made on the Banknote identifier?
   I. Use of different materials such as rubber, wood, metal, or hard plastic.
   II. Printing without the pocket and the balancing space.
   III. Use of more identical tactile marks like dots or arrow marks.
   IV. Changing the orientation of the identification lines to vertical orientation.
2. Apart from the above, what other modification would you prefer on the device to make it more user-friendly? Please explain.

……

……

……

……

Thanks a lot for your great cooperation and contributions.

Appendix II: Experiment Specimen

Card Reader


10000


10000
10000


10000

Appendix II: Consent Form

KYAMBOGO UNIVERSITY

FACULTY OF SPECIAL NEEDS AND REHABILITATION

DEPARTMENT OF SPECIAL NEEDS STUDIES

P.O BOX 1, KYAMBOGO

Tel 0414-286237/8/285584, 222935, Fax 0414-222961

CONSENT FORM

Dear participant,

I am a student of Kyambogo University pursuing a master's of special needs education. I am carrying out a research study on the topic: **'*perception of persons who are blind on the use of non-digital Ugandan BANKNOTE identifier***. Its hoped that the findings of the study will among others: Enable the inventor improve on the non-digital Banknote identifier, making it more user-friendly to persons with blindness, help to strengthen financial literacy and economic empowerment as well as easing the financial transactions of persons with blindness, and equally promote financial inclusion of persons who are blind by strengthening a Banknote identification system that makes possible their direct involvement in business activities.

You have been identified as one of the participants who can inform the study through an experiment and an interview. The interview will focus on study objectives and is likely to last 25-30 minutes. I kindly request you to participate in the study by sharing your ideas and permitting the researcher to record your voice, take your picture/video where necessary. Whatever information you

provide will be used for the purpose of the study and academics only and will be kept confidential. You will be free to withdraw from the study in case you fill uncomfortable proceeding with the participation.

Your support and cooperation are highly appreciated.

Yours sincerely

Ayoli Moses

Confirmation of acceptance

I have read and understood the purpose of the study and I hereby consent to participate.

Name…… Signature……

Date……

Appendix III: Introductory Letter

KYAMBOGO UNIVERSITY

P. O. BOX 1, KAMPALA
FACULTY OF SPECIAL NEEDS & REHABILITATION
Tel: 0414-286237/285001/2 Fax: 0414-220464
DEPARTMENT OF HEARING IMPAIRMENT & SIGN LANGUAGE INTERPRETATION STUDIES

8th May, 2023

The DEO/DIS/Head teacher/Teacher/Community/Opinion Leader/Church Leader
.....THE CHAIRPERSON.....
.....LIAUPED.....

Dear Sir/Madam,

RE: INTRODUCTION OF RESEARCH STUDENT ON DATA COLLECTION

This is to introduce the bearer Rev/Dr/Sr/Mr/Mrs /Ms.....AYOLI MOSES.....
Reg.No:...20/U/GMSN/13086/WKD who is a bonafide student of Kyambogo University in the Faculty of Special Needs and Rehabilitation, Department of Special Needs Studies. As partial fulfillment of the requirement for the award of the Diploma/Degree/Masters, he/she is required to undertake a research on the approved area of study.

The purpose of this letter is to request you to allow him/her have access to information from your office, school or area of operation necessary for the study.

Kyambogo University will be grateful for any assistance rendered to the student.

Yours faithfully,

Pp Dr. Sam Lutalo-Kiingi
HEAD OF DEPARTMENT