A SIMULATING CHATBOT PROTOTYPE FOR TRAINING USERS ON BLOCKCHAIN TECHNOLOGY

BY

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DECLARATION

DECLARATION BY THE CANDIDATE

I hereby declare that this thesis is my original work prepared with no other than the indicated sources and support and has not been presented elsewhere for a degree or any other award.

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DECLARATION BY THE SUPERVISORS

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DEDICATION

I dedicate this work to my parents who have been very supportive, loving and caring throughout my study period.

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ABSTRACT

With the rise of complex new technologies such as Blockchain, there is need for development of systems that can be used to teach and learn these technologies. A simulative Chatbot is one such revolutionary system of technology that can be used to teach and learn these modern technologies. The aim of this study was to determine the effectiveness of the current systems in learning Blockchain with a view of developing a Chatbot prototype to learn Blockchain technology. The objectives of the study were to: determine the effectiveness of the current systems in learning Blockchain technology; analyze the simulative Chatbot in relation to the learning of Blockchain technology; and design and develop a simulative Chatbot for learning Blockchain technology. The theoretical framework adopted was informed by Siemen's theory of Connectivism and B.F Skinner's Theory of Behaviorism. The study adopted a mixed method research approach for requirement gathering and analysis and evolutionary prototyping for the prototype development. The target population comprised of all 130 active Institute of Electrical and Electronics Engineers (IEEE) Moi University chapter members. Stratified random sampling technique was used to select 114 respondents as follows; 21 IT consultants, 19 computer scientists, 8 lecturers from IEEE, 34 IT students, 4 IT business persons, 22 engineers, and 6 learners from fields outside IT. Data collection instruments were: Online Google forms and document analysis. Ethical considerations were anti-plagiarism checks and permission from the National Commission for Science, Technology and Innovation. The Chatbot runs on an Android mobile platform. The reliability of the prototype developed was achieved by the consistency of the outcomes obtained through repeated closed testing and by including test results attained from the Google play console testing. The findings revealed that the simulating Chatbot enables learners to learn more about Blockchain technology. From the testing of the prototype it was revealed that the prototype had 98% stability on touch target size. The testing showed that learners were able to learn the Blockchain concept with ease. The study concludes that the learning of Blockchain technology needs special training for better understanding. The study recommended that there was need to develop systems such as android applications that can teach complex new technologies such as Blockchain. Theoretical and practical contributions have been made to advance understanding of effective teaching and learning strategies and enhance the accessibility, engagement, and outcomes of a blockchain education

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ABBREVIATIONS

AI – Artificial Intelligence

APK- Android Application Package

C41 Team – Chromogenic 41 Team.

Dapps – Distributed applications

DLT – Distributed Ledger Technology

Gifs - Graphics Interchange Formats

HP COMPAQ – Hewlett-Packard Compatibility and Quality

IBM – International Business Machines Corporation

ICOs – Initial Coin Offering

ICT - Information and Communication Technology

IEEE - Institute of Electrical and Electronics Engineers

IQ – Intelligence Quotient

IT - Information Technology

NACOSTI - National Commission for Science, Technology and Innovation

Q n A – Question and Answer

Std Dev – Standard Deviation

UI – User Interface

CHAPTER ONE

INTRODUCTION

1.0 Background Information of the Study

Blockchain is considered one of the most significant technological innovations in this century by IT experts such as Nathan Reiff. It is seen as the technology that might revolutionize all fields, including education (Reiff, 2021). In the present century, technologies keep changing, and new ones keep coming up. Iansiti & Lakhani (2017) define Blockchain as a digital database containing information, such as records of financial transactions, that can be simultaneously used and shared within a large decentralized, publicly accessible network. According to Bernard (2018), Satoshi Nakamoto was the first to use Blockchain; they released the whitepaper Bitcoin, a peer-to-peer electronic cash system, in 2008. He further states that Blockchain, the technology that runs Bitcoin, has developed over the last decade into one of today's most significant ground-breaking technologies. Another scholar, Nitish (2020), argues that Blockchain is not new since Stuart Haber and W. Scott Stornetta 1991 also envisioned something similar to Blockchain. They created their first cryptographically secure chains of blocks with timestamps so that no one could tamper with them.

According to the Kenyan Wall Street (2020), the government began setting up a task force on 18th January 2018 as a comprehensive strategy to encourage and adopt emerging technologies such as Blockchain and artificial intelligence. Several Kenyans have studied Blockchain and how to use it in day-to-day activities. For example, Mara-Florina (2020)

explains Blockchain in Education, keeping in mind the opportunities, applications, and challenges. The study states that Blockchain in Education enhances and motivates lifelong learning. One may need new technology to effectively pass on knowledge about Blockchain, such as incorporating a Chatbot in a simulator.

A simulator is something that is programmed to execute different programs that have been written to perform specific tasks. For example, in this study, the simulator can teach Blockchain. According to David, Richard & James (2009), Simulators were first discovered during World War 2 by two mathematicians: Jon Von Neumann and Stanislaw Ulam. World War 2 lasted from 1939 to 1945 and was known as the pre-computer era. Mwangi, Joel & Eric (2005) stated in their study that they created a simulator that used vibrant color graphic images capable of presenting the dynamic nature of the education process in secondary schools. They further stated that the program enabled learners to aggregate their insights through co-elaboration and self-teaching while interrogating the learning experiences presented by the simulation. Simulators have many advantages. For example, Peter & Kincaid (2009) state that simulators are: applicable to students of all levels and ages, help students see complex relationships that would otherwise involve expensive equipment or dangerous experiments, allow for math, science, and technical skills to be taught in an applied, integrated manner, provides students with new methods of problem-solving, provides realistic training and skills for a multitude of career areas, is used extensively in science and industries, Is cost-effective and reduces risks to humans. For the simulator in question to work effectively, there is a need for a Chatbot.

Learning tools are becoming smarter with the advent of new technologies. For example, Areeba (2019) states that AI-powered Chatbots have introduced a new learning culture.

Therefore, this makes the study of Chatbots very essential before creating the simulator with a Chatbot within it. According to Skill (2019), a Chatbot is artificial intelligence software that simulates different types of conversations using natural language that humans use in their daily lives. On the other hand, Webster (2021) defines a simulator as a device or program which artificially creates the effect of being in conditions of some kind and is used in training.

The TechTarget network newsletter (2021) states that a Chatbot is a software application used to conduct an online chat conversation via text or text-to-speech instead of providing direct contact with a live human agent. According to Nick (2019), Chatbots was first developed in 1966 by a scholar known as Professor Joseph Weizenbaum. The first Chatbot was known as ELIZA, programmed to answer some straightforward tree questions. Kenyan scholars have done several studies on Chatbots. For example, Alexander (2019) did a study on a model for the adoption of Chatbots in Kenya. He explains the different models that can be used to adopt Chatbots and also highlights the history of Chatbots and how they generally work. This study becomes essential when it gives a broad idea of the best ways to use Chatbots, giving us various ideas. According to Winkler & Sollner (2018), Chatbots have become a ubiquitous trend in many fields, such as medicine, the product and service industry, and education. He further states that Chatbots are essential in cases with many students and few lecturers and can offer individual student support.

In the case of this study, several technologies have been used together. For example, the researcher has incorporated a Chatbot into a simulator to create a tool that helps transmit Blockchain knowledge to interested parties such as business learners, students, lecturers,

and others. Several learners have highlighted that learning Blockchain is challenging; therefore, a simulator would fill this gap.

1.1 Statement of the Problem

The rapid introduction of new technologies in the market requires individuals to learn, understand, and apply them daily. One such technology is blockchain, which many learners are interested in learning but need help comprehending fully. Research findings from A. Johnson and B. M. Jackson, published in the "Journal of Research in Business Information Systems," emphasize that blockchain's decentralized and cryptographic design can be conceptually demanding for learners. This complexity is often compounded by a lack of familiarity with cryptographic concepts and the decentralized ledger structure, contributing to difficulties in achieving a deep understanding. However, current teaching methods often fail to engage students effectively. This problem affects learners, who may need more comprehensive knowledge or help to explain certain concepts. Studies by M. Zohar and D. Luria, discussed in the "International Journal of Information and Communication Technology Education," reveal that conventional lecture-based approaches struggle to maintain students' sustained interest and involvement when dealing with intricate technological subjects like blockchain.

The gap between learners' enthusiasm for understanding blockchain and the challenges they encounter in comprehending its intricacies, combined with the limitations of traditional teaching methodologies, underscores the pressing need for innovative educational solutions. In response, the development of a simulating Chatbot prototype, as outlined in the study, emerges as a promising approach. The system not only seeks to

address the difficulties faced by learners but also enhances comprehension and encourage further exploration of emerging technologies like blockchain. Furthermore, the simulator empowers learners and tutors to explore blockchain components at their own pace by providing a flexible and convenient learning environment. Incorporating interactive features like the Chatbot and quizzes enhances the learning process. The effectiveness of the simulator was measured through metrics including learner comprehension, user-friendliness, and application usability. Finding innovative and enjoyable ways for individuals to learn and engage with new technologies is crucial for the education industry.

1.2 Aim of the Study

The aim of this study was to determine the effectiveness of the current systems in learning Blockchain with a view of developing a Chatbot prototype to learn Blockchain technology.

1.3 Objectives of the Study

The following are the objectives of the study:

i. Determine the effectiveness of the current systems in learning Blockchain technology.
ii. Analyze the existing simulative Chatbots in relation to the learning of Blockchain technology.
iii. Design and develop a simulative Chatbot for learning Blockchain technology.

1.4 Research Questions

The research questions that guide this work include:

i. How effective are the current systems in teaching and learning Blockchain technology?
ii. What are the existing simulative Chatbots and their functions?
iii. How will the end product look like and which features will be in-cooperated in it?

1.5 Significance of the Study

This study establishes the challenges learners face when trying to learn new complex concepts. The following learners can benefit from the study:

Blockchain developers – A Blockchain developer is any person who builds applications linked to Blockchain, for example, decentralized applications. Before deciding to be a Blockchain developer, one needs to know what Blockchain entails. This group of learners can learn all the concepts of Blockchain so that they can know the weaknesses and strengths of the technology. It enables them to know how to patch all the loopholes intruders would use to make their applications at risk. It also enables them to build more vital systems. The developer knew whether Blockchain could be integrated with other technologies to create something hybrid and get insights on how they can do it.

Tutors and lecturers – These are the Teachers who teach Blockchain. Blockchain is a revolutionary technology; therefore, more and more cramps are added to it, making it hard to learn. What the tutor taught before might not be applicable later, but they still have to teach the concept. In this case, they can upgrade what they know. They can know where to refer students to learn a concept further. They can also advise students on the Blockchain career paths based on the knowledge they would have gathered. Lastly, they can know the kind of material to use in teaching Blockchain in their classes.

Learners – This group includes students in learning Institutions or anyone interested in learning Blockchain but not in a learning institution. The knowledge the students get shapes a promising career for them. Blockchain professionals can be trained to improve their expertise in Blockchain technology. They can learn Blockchain-related skills and knowledge which they apply in building Dapps.

Blockchain Researchers – This includes learners who are researching Blockchain and want to know how it works so that they can be able to gather more information or propose a solution to an existing problem that they are trying to solve. Many learners can be able to know the strengths and weaknesses of Blockchain and be able to know how to use the information in their various research works.

Business learners – In today's fast-paced and technologically driven business landscape, staying ahead of the competition is crucial for sustained success. Blockchain technology has emerged as a transformative force, offering numerous benefits across industries. To fully capitalize on the potential of blockchain, businesses must understand its intricacies and adapt their operations accordingly. A simulating chatbot designed to train users on blockchain technology can play a pivotal role in empowering business people to gain a competitive advantage in this rapidly evolving environment. Blockchain has the potential to revolutionize how businesses operate by enhancing security, transparency, and efficiency.

By understanding the underlying principles of blockchain, businesses can identify opportunities to streamline processes, reduce costs, and create innovative solutions that meet customer demands. Blockchain opens doors to new markets and collaborations. It

enables businesses to participate in decentralized networks, fostering trust and enabling seamless transactions across borders. By leveraging blockchain, companies can access untapped customer bases, forge strategic partnerships, and explore novel revenue streams, thereby gaining a competitive edge. Blockchain's distributed ledger technology offers robust security measures that safeguard sensitive business data. Through a simulating chatbot, businesses can train their personnel on best practices for securing data and leveraging blockchain's immutability. This knowledge equips them to protect their operations from cyber threats and build trust with customers, ultimately positioning the company as a reliable and secure partner. Blockchain's ability to provide end-to-end traceability and immutability is a game-changer for supply chain management. By training business people on blockchain technology, companies can optimize their supply chains, ensuring transparency, authenticity, and accountability. This streamlined approach enables businesses to respond quickly to disruptions, reduce inefficiencies, and provide superior customer experiences. Smart contracts, powered by blockchain, automate and enforce agreements without intermediaries.

By understanding how smart contracts function, businesses can streamline complex transactions, eliminate middlemen, and reduce costs. A simulating chatbot can train users on designing and deploying smart contracts, enabling businesses to gain a competitive advantage by reducing friction and enhancing trust in contractual relationships. In today's digital era, understanding and leveraging blockchain technology can offer businesses a significant competitive advantage. A simulating chatbot designed to train users on blockchain empowers business people with the knowledge and skills required to navigate this disruptive technology successfully. By embracing blockchain, businesses can

streamline operations, enhance data security, explore new market opportunities, and drive innovation. Ultimately, gaining a competitive edge in the market relies on understanding and leveraging blockchain, and a simulating chatbot acts as a valuable tool in achieving this objective.

Entertainers – These learners do art such as recording songs, acting, book writing, drawing, and other things geared towards entertaining learners. By knowing how Blockchain works, they can know the back-end happenings of what happens when they send their content straight to the consumer. Blockchain enables them to cut off intermediaries and middleware apps that possess all their royalties and pay them peanuts. They can also learn how to distribute their content online effectively and securely.

1.6 Scope of the Study

The scope of this study was to design, construct, and test a simulating chatbot prototype for training learners on blockchain technology. The research was a thorough assessment of the literature to understand better the present status of blockchain technology and existing approaches to user training. The study used a mixed-methods approach, including online questionnaires, to collect data on user needs, preferences, and knowledge gaps. The simulating chatbot prototype was created, incorporating interactive aspects and simulated settings to provide users with an entertaining and informative experience. User testing and feedback analysis assessed the chatbot's effectiveness and usability. The study's findings contributed to the field of blockchain education by offering insight into the efficacy of chatbot-based teaching and highlighting areas for improvement in user learning outcomes.

1.7 Limitations of the study

The limitations of this study include the following:

Simulated Environment: The study may have used a simulated environment to train users on blockchain technology. While this approach allows for controlled experiments, it may not fully replicate real-world scenarios, and users' reactions or behaviors in a simulated setting may differ from those in actual usage.

Artificial Intelligence Limitations: The chatbot prototype's AI capabilities may need to be improved in understanding and responding to complex user queries or providing accurate and comprehensive information on blockchain technology. These limitations should be acknowledged as potential constraints on the effectiveness of user training.

Technical Constraints: The chatbot prototype may have technical limitations or dependencies, such as internet connectivity, platform compatibility, or processing capabilities. These constraints may impact the chatbot's performance and user experience during training.

Time and Resource Constraints: The study may have faced limitations regarding time and available resources for developing and testing the chatbot prototype. These constraints could affect the development process's thoroughness or the evaluation's scope, requiring researchers to acknowledge and consider the potential impact on the study's outcomes.

1.8 Operational definition of key terms.

Android: This operating system is open source and is used by smartphones and tablets.

Artificial intelligence: This is designing an application to perform tasks that a human being does with intelligence on a day-to-day basis. These tasks include things like decision-making and voice recognition.

Blockchain: This immutable ledger system records information, making it impossible or hard to interfere with at any time.

Expert: This person is very knowledgeable about a concept or job and has the skills to tackle anything in the given field.

Learning: One gain new knowledge in a particular skill or concept.

Mixed method research: Mixed methods is collecting, analyzing, and mixing both quantitative and qualitative research and methods in a single study.

Novice: This is a person who does not have any experience in something. In most training platforms, they are known as beginners.

Prototype: This is a working model or blueprint of a product created to demonstrate a system that will be fully developed later.

Qualitative research: According to Scribbr (2020), qualitative research entails collecting and analyzing data that is not numerical. Non-numerical data includes videos, texts, and audio. Qualitative research has several data collection methods: interviews, secondary research, case studies, artifacts, questionnaires, observations, focus groups, and surveys.

Teaching: This is where an authority engages with learners to enable them to understand a concept.

User interface: This is where the human and device interact. The person can interact with either an application or a website.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

A literature review is a critical summary and evaluation of existing research and scholarly articles on a specific topic. It provides an overview of the current state of knowledge, identifies gaps, inconsistencies, and debates in the literature, and establishes the foundation for new research. A literature review involves systematically searching, analyzing, and synthesizing relevant literature to address specific research questions or objectives. (Smith, J. D., & Johnson, A. B., 2022). It critiques the relevant literature published on learning Blockchain, simulators, and Chatbots; it identifies gaps in the existing research and provides a contextual background for the research conducted. The theoretical framework that the study was based on is also discussed in this section.

2.1 Learning Simulators

A simulator is a software that uses models to imitate a specific operation in the real world. According to BusinessDictionary.com, a simulator is a computer program (such as a game or animated flowchart) or a dedicated device that models some aspects of a real-life situation. Additionally, it can be explained as a technique where a software program models the behavior of a network by calculating the interaction between different entities (BusinessDictionary.com, n.d., para. 2017).

According to Aldrich (2009), a learning simulation is an experience designed to help users develop competence and conviction rigorously. A learning simulation is a combination of modeling elements, entertainment elements, and instructional elements. The applications that can be used to make simulators include ITY studio, Anylogic, Simul8, Storyline, Matlab, Cosmol Multiphysics, Captivate, Simscale, and many other applications. There are several modeling and simulation simulator types. They include motor control skills like flying an airplane; decision skills, for example, committing the fire control resources to action; and communication skills, for example, the members of a C41 team. An example of a simulator is as figure 1 below:

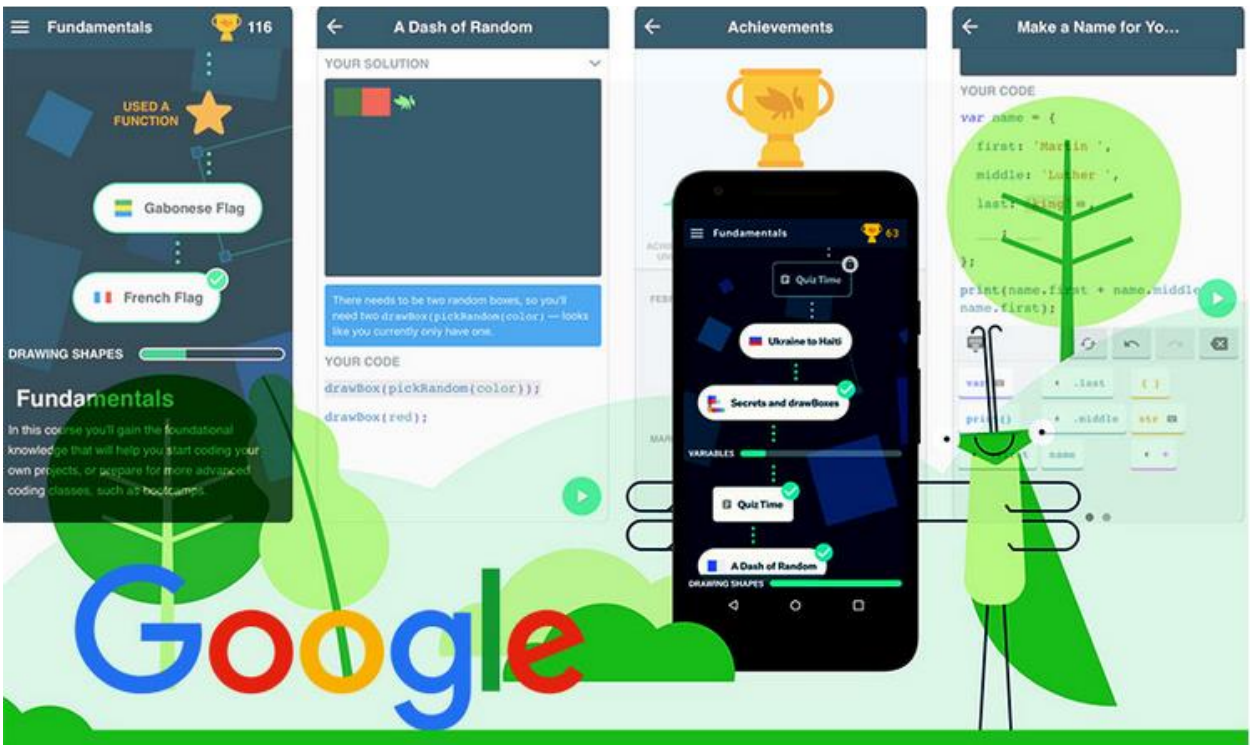

Figure 1: Example of a simulator

Note. Figure 1 is an example of a simulator (a screenshot of the Google coding simulator grasshopper application) From Now it is easy to learn coding via grasshopper app by CIO

Bulletin, 2018. (https://www.ciobulletin.com/software/google-launched-grasshopper-app). Copyright 2021 by CIO Bulletin Inc.

Simulators have become increasingly prevalent in education, offering valuable opportunities for teaching and learning. These computer-based tools provide immersive and interactive environments replicating real-world scenarios, allowing learners to engage in authentic experiences. This paper explores the role of simulators in teaching and learning and discusses their benefits and implications.

One of the key advantages of using simulators in education is their ability to provide hands-on, experiential learning opportunities. Simulators enable learners to actively engage in realistic simulations of complex tasks or situations, allowing them to develop practical skills and knowledge in a safe and controlled environment (Anderson et al., 2019). For example, medical simulators allow students to practice surgical procedures or diagnose patients, enhancing their clinical skills and decision-making abilities.

Moreover, simulators can facilitate active learning by promoting exploration, experimentation, and problem-solving. Learners can interact with the simulated environment, test different strategies, and observe the immediate consequences of their actions (Kizilcec et al., 2017). This hands-on approach fosters critical thinking and decision-making skills and deepens conceptual understanding by bridging theory and practice.

Incorporating simulators into educational curricula also allows for personalized and adaptive learning experiences. Simulators can provide individualized feedback and guidance based on learners' actions and performance, tailoring the learning experience to their needs (Dieker et al., 2014). For instance, flight simulators can track and analyze a

pilot's maneuvers, providing targeted feedback to improve their flying techniques. This personalized approach enhances learning outcomes and increases learner engagement and motivation.

Simulators enhance skill acquisition and retention. Research by Smith and Johnson (2018) found that learning simulators significantly enhance skill acquisition and retention compared to traditional instructional methods. The interactive nature of simulators allows learners to actively engage in realistic scenarios actively, facilitating hands-on learning and improving knowledge transfer.

Simulators foster critical thinking and problem-solving skills. Thompson et al. (2019) state that learning simulators promote critical thinking and problem-solving skills by presenting learners with complex, real-world challenges. Simulators provide a safe environment for learners to experiment, make decisions, and observe the consequences of their actions, fostering analytical thinking and decision-making abilities.

Bridging the Gap between Theory and Practice: Learning simulators bridge theoretical knowledge and practical application. In their study, Hernandez and Martinez (2020) found that simulators effectively facilitate the transfer of theoretical concepts into real-life contexts. Learners can explore and apply their knowledge in simulated environments that resemble authentic situations, improving their ability to transfer learned skills to real-world settings.

Furthermore, simulators enable learners to overcome logistical and safety constraints associated with real-world training. In fields such as aviation, healthcare, and engineering, where costly equipment and potential risks are involved, simulators offer a cost-effective and risk-free alternative for skill development and assessment (Anderson et al., 2019).

Learners can repeatedly practice and refine their skills in simulated environments without compromising safety or incurring additional expenses.

However, the implementation of simulators in education also poses challenges and considerations. Adequate training and support for educators and instructors are crucial to ensure the effective integration and utilization of simulators (Horton, 2012). Educators need to be familiar with the capabilities and limitations of simulators and possess the skills to facilitate meaningful learning experiences within these virtual environments.

Additionally, it is essential to critically evaluate the authenticity and transferability of learning outcomes achieved through simulators. While simulators provide valuable training experiences, the extent to which skills acquired in simulated environments translate to real-world contexts should be examined entirely (Dieker et al., 2014). It is essential to bridge the gap between simulation and application, ensuring learners can successfully transfer their knowledge and skills to real-world settings.

In conclusion, simulators offer significant benefits for teaching and learning, providing hands-on, experiential learning opportunities, promoting active engagement and problem-solving, and enabling personalized and adaptive learning experiences. By leveraging simulators effectively, educators can enhance skill development, bridge the gap between theory and practice, and overcome logistical and safety constraints. However, careful consideration of training and support for educators and critical evaluation of learning outcomes are necessary for the successful integration and utilization of simulators in education.

2.2 Artificial Intelligence in Teaching and Learning

According to Copeland (2021), artificial intelligence is the ability of a computer to perform processes in the same way as an intellectual being. In the context of this project, artificial intelligence gets employed through the use of a Chatbot.

Broke (2020) explains that Design Science Research is a paradigm focused on enhancing human knowledge by creating technologies that improve human capabilities. This paradigm mainly applies to engineering and artificial intelligence projects. The system developed in this project aims to teach a challenging concept but is crucial for economic and knowledge-based development. Examples include learning how to mine bitcoins or secure corporate transactions using blockchain technology, which aligns with the principles of design science research.

Artificial Intelligence (AI) has emerged as a powerful educational tool, revolutionizing teaching and learning processes. AI technologies like machine learning and natural language processing provide personalized, adaptive, and intelligent learning experiences (Dabbagh et al., 2019).

One of the critical advantages of AI in education is its ability to provide personalized and adaptive learning experiences. AI algorithms analyze learner data to tailor educational content and activities to individual needs (Dabbagh et al., 2019).

Moreover, AI-powered educational tools, such as chatbots and virtual assistants, engage in interactive conversations with students, answer questions, provide explanations, and offer guidance (Koedinger et al., 2015). These tools act as virtual tutors, assisting learners in understanding and consolidating their knowledge.

Incorporating AI technologies in education also automates administrative tasks, freeing time for educators to focus on instruction (Hartshorne et al., 2016). AI systems assist with grading, data analysis, and administrative workflows, enhancing efficiency.

Furthermore, AI technologies facilitate collaborative learning experiences by promoting interaction and communication among learners (Dabbagh et al., 2019). AI algorithms can form suitable groups or pairings and create virtual collaborative spaces and platforms for discussions and project collaboration.

However, ethical considerations regarding privacy, data security, and potential biases in AI algorithms get addressed in educational settings (Van Dam, Numan, & van der Schaaf, 2021). Educators should be aware of the limitations of AI systems and exercise critical judgment to ensure responsible implementation.

In conclusion, AI technologies can potentially transform teaching and learning by providing personalized, adaptive, and collaborative educational experiences. While their benefits are significant, addressing ethical considerations and recognizing AI systems' limitations and potential biases in education is essential.

2.3 Teaching and Learning Chatbots

According to Constantine (2018), Chatbots are programs that have intelligent, meaningful conversations with humans. They are a creation to aid customers' access to desired products; they accomplish this through interactions with clients based on details obtained to redirect the marketers on the type of product required. Figure 2 is an example of a Chatbot:

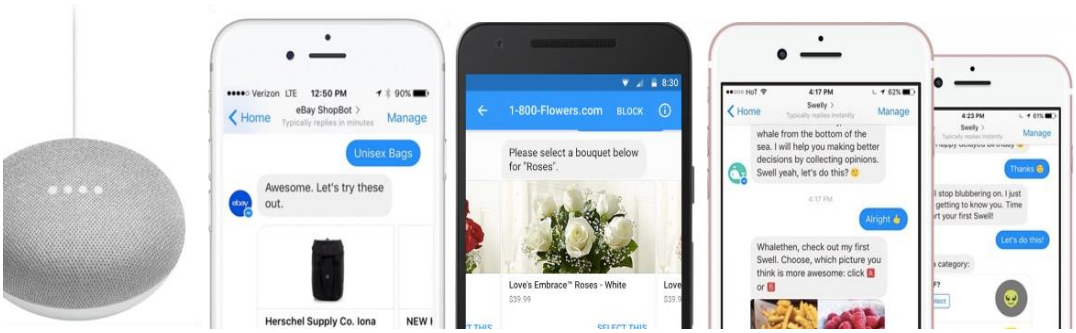

Figure 2: Example of a Chatbot

Note. Figure 2 is an example of Chatbots (a screenshot of the best designed Chatbots) Chatbot examples: 5 of the best designed Chatbots (Vittorio, 2018). (https://botsociety.io/blog/2018/03/chatbot-examples/). Copyright 2018 by Botsociety.io

In the book called "Introducing Azure Bot Service," by Waghmare (2018), it is stated that there are two types of bots which include: AI-based bots, which are machine learning bots, and fixed bots or multiple-choice bots, which are rule-based and programmed with entire content. It can be controlled safely and script based. There are several Chatbot building platforms which, include: Chatfuel, which has been the best application for creating a Facebook Chatbot, Motion.ai which is an artificial intelligence application that enables the user to build a Chatbot visually; BrainShop API, which is specifically designed to create Chatbots on Android studio and so many other applications that can be engineered to create Chatbots on different platforms. In the case of this study, BrainShop API is what was used. It was the best application because the bot created can understand things and give feedback as humans do.

According to Essel (2022), several advantages are attributed to Chatbots. These advantages include: There is the integration of several systems which can communicate with each other

to do different functionalities; for example, Chatbot technology can work with any other systems, Chatbots provide extensive assistance to the student, it presents the student with rich content with tutorial pages, images, videos and can even be asked questions, Chatbots are always available in the case where help is needed, it allows one to start a conversation with it regarding any issue, any time of the day, the Chatbot has been programmed to give automatic answers to repetitive questions and forward the request to a natural person when a more complicated action is needed, the Chatbot contributes by making the engagement more interactive, usually with a great sense of humor, it does not bore the learners and keep them flowing by maintaining the conversation, lastly, with feedback the Chatbot collected through simple questions, one can improve their answers.

According to Kuhail et al. (2023), Chatbots have developed as creative educational tools, opening up new avenues for teaching and learning. Natural language processing capabilities enable these computer programs to replicate human communication and engage with users conversationally. Chatbots have grown in popularity in educational settings in recent years due to their ability to improve many parts of the learning process.

The capacity of chatbots to provide tailored and adaptable learning experiences is one of the primary benefits of employing them in education. Chatbots can assess learner interactions and answers to customize content and activities to individual needs and preferences (Chen, 2018). A language learning chatbot, for example, can modify the difficulty level of exercises based on the learner's ability level and provide targeted feedback to develop specific language skills. This individualized approach encourages active participation and allows students to progress at their speed.

Furthermore, chatbots can act as virtual teachers, providing learners with rapid feedback and guidance. Chatbots enable students to obtain timely assistance by offering real-time responses to queries and clarifications, boosting their learning and problem-solving skills (Zhang et al., 2019). Furthermore, chatbots can be available 24 hours a day, seven days a week, circumventing the restrictions of traditional classroom settings and allowing learners to access educational resources and help at any time.

Chatbots in instructional design can also promote collaborative learning experiences. Chatbots can help students communicate with one another by encouraging them to participate in discussions, exchange ideas, and solve problems together (Bickmore et al., 2019). These collaborative aspects encourage social learning and the development of critical thinking and communication skills, both of which are necessary for success in the digital age.

While chatbots provide significant advantages for teaching and learning, their use poses ethical concerns. Privacy and data security are critical when using chatbots in educational settings (Dey et al., 2020). Educational institutions must ensure that sensitive student information is safeguarded and that chatbots adhere to applicable privacy laws.

Furthermore, the potential limitations of chatbots in teaching must be considered. While chatbots excel at processing text-based responses, they may need help understanding and answering complicated or nuanced requests (Chen, 2018). Furthermore, chatbots lack the human touch and empathy that human teachers provide, which might be critical in some learning scenarios.

Finally, chatbots have the potential to transform teaching and learning by providing personalized, adaptive, and collaborative learning experiences. These intelligent

conversational bots can provide instant feedback, facilitate personalized learning, and encourage peer interactions. However, ethical concerns about privacy, data security, and the limitations of chatbot capabilities should be considered during implementation. Educators may improve the learning journey and prepare students for the challenges of the digital world by successfully utilizing the potential of chatbots.

2.4 Blockchain Technology

Blockchain technology has gained significant attention due to its potential to revolutionize various industries. Blockchain's complexity and technical nature challenge learners who want to understand its principles and applications. Blockchain technology involves intricate concepts such as decentralized networks, cryptographic algorithms, consensus mechanisms, and smart contracts. Research by Johnson et al. (2018) highlights the complexity of Blockchain, emphasizing the need for learners to grasp both technical and conceptual aspects. Understanding Blockchain's underlying principles and mechanisms can be daunting, requiring a solid computer science and cryptography foundation.

Technical Prerequisites are needed to learn Blockchain. Learning Blockchain requires a strong understanding of programming languages, cryptography, and distributed systems. Kaya and Okur (2020) assert that learners must possess programming skills in languages like Solidity to develop smart contracts and interact with blockchain platforms. A lack of technical expertise can impede learning, making Blockchain appear even more challenging.

There are Limited Learning Resources to learn Blockchain. The availability of comprehensive and accessible learning resources is crucial for effectively understanding the Blockchain. However, research by Li et al. (2019) indicates that the need for high-

quality educational materials is a significant challenge for learners. The dynamic nature of blockchain technology also makes it difficult to find up-to-date and reliable resources. Moreover, the lack of standardized curriculum and formal education programs further exacerbate the difficulty in learning Blockchain.

The evolving nature of Blockchain makes learning hard. Blockchain technology continuously evolves, with new developments, updates, and advancements emerging rapidly. This rapid evolution challenges learners to keep pace with the latest trends and innovations. Research by Smith and Johnson (2021) suggests that the dynamic nature of Blockchain creates a constant learning curve, demanding continuous self-directed learning and staying updated with industry developments.

Lack of Practical Experience in Blockchain makes it hard to learn. The practical application of blockchain concepts is crucial in understanding its functioning and potential. However, the limited availability of practical experiences and hands-on opportunities in blockchain learning can hinder learners' comprehension. Research by Chen and Wang (2020) suggests that the absence of real-world use cases and practical exercises in educational settings makes it challenging for learners to apply their theoretical knowledge effectively.

This literature review supports the statement that learning Blockchain is challenging. The complexity of blockchain technology, technical prerequisites, limited learning resources, the evolving nature of Blockchain, and the lack of practical experiences contribute to the difficulty in acquiring a comprehensive understanding of Blockchain. Recognizing these challenges informed the development of the practical educational approach and support system to enhance blockchain learning outcomes.

According to Sai (2019), Blockchain is a distributed and immutable ledger allowing you to track almost anything tangible or intangible. It is used to track transactions, for example, cryptocurrency and bitcoin. For a transaction, a node in a Blockchain broadcasts to other nodes directly, as shown in Figure 3.

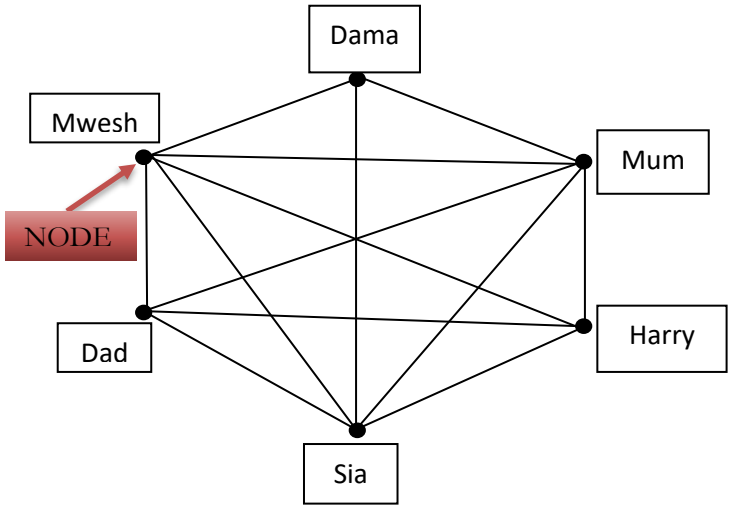

Figure 3: How Blockchain works

Note. Figure 3 is an example of a Blockchain transaction (a screenshot of how Blockchain works) How does a Blockchain work-Simply explained by Xavier Savjee, 2017. (https://www.youtube.com/watch?v=SSo_EIwHSd4). Copyright 2011-2021 by Xavier Decyper

Every node has a different ID. Blockchain is explainable using the family setting. The names on the nodes symbolize the initiators of the transactions. If Dama were to borrow

money from Dad, everyone would see the transaction. Every node keeps a record of all the transactions. So, if Dama asked how much she would pay back, everyone there would give feedback. It means that the transaction information cannot be compromised. Ledgers existed before Blockchain, but Blockchain beats them due to its distributed nature, where every node has an identical copy of the information.

According to Veera (2022), Blockchain has several benefits, which include: an increase in security, increase in transparency, and accountability, an increase in trust, ensured traceability of information shared on different networks, enhanced automation, enhanced cost-saving, reduced paperwork, enhanced efficiency, reduce errors, reduce transaction costs, faster transactions, eliminate the need for transaction verification middlemen, fast problem solving, reduce delays and save time, an increase of operational efficiencies, ensure privacy, ensure immutability, enhance innovation, enhance real-time data sharing, free from censorship, easy tracking of transactions, everyone can have access to Blockchain, information on Blockchain is verifiable, records are permanent, reduced hacking threats and enhancing of individual control of data.

The challenges that face Blockchain include difficulty in learning since it is a complex technology, much capital needed to roll out the technology, Blockchain does not offer interoperability, it is time-consuming to add a new block, it cannot be scaled, high power consumption because of the mining activities that take place when creating nodes, Blockchain can be slow in the case where there are many learners on the network, it is challenging to create updates on nodes, to create data on Blockchain one needs tech-savvy learners, Blockchain needs the support of other systems to ensure that the data entered in the Blockchain system is accurate, it can bring insecurity because a person is trackable on

a network and lastly, as the number of transactions grows, the number of Blockchain blocks also increases meaning that the database should increase.

Blockchain technology has gotten much attention in recent years because of its potential to transform various industries and operations. This paper gives an in-depth examination of Blockchain, covering its fundamental ideas, properties, and applications. It also investigates the advantages and disadvantages of this disruptive technology. (Nakamoto, 2008) *Blockchain* is a decentralized and distributed ledger technology that enables secure and transparent transactions and data sharing. It runs on a network of interconnected nodes, keeping a copy of the entire Blockchain. Transactions are organized into cryptographically linked blocks to form an immutable chain.

The decentralized nature of Blockchain is one of its essential foundations. Unlike previous centralized systems, Blockchain facilitates peer-to-peer transactions and consensus processes and eliminates the need for middlemen (Swan, 2015). This decentralization provides transparency, trust, and resilience by distributing control and data across the network.

Several essential elements of blockchain technology contribute to its unique value proposition. For starters, it provides immutability, which means that once a transaction gets recorded on the Blockchain, it is permanent and cannot change without the consensus of network participants (Mougayar, 2016). This impermanence improves data integrity and security. Furthermore, Blockchain promotes transparency by enabling all parties to examine and validate transactions recorded on the ledger (Zheng et al., 2017). Because any modifications or discrepancies can be quickly discovered and documented, this transparency fosters confidence and responsibility.

Another essential feature of Blockchain is its capacity to facilitate secure transactions without intermediaries. Blockchain maintains the integrity and validity of transactions by using cryptographic algorithms and consensus procedures, reducing the risk of fraud and manipulation (Tapscott & Tapscott, 2016). Blockchain's potential applications go beyond cryptocurrency transactions. Various industries, including finance, supply chain management, healthcare, and governance, have recognized blockchain technology's disruptive prospects (Swan, 2015). For example, Blockchain can expedite and automate cross-border payments, improve supply chain transparency and traceability, provide secure and interoperable health data, and enable decentralized voting systems.

Despite its tremendous benefits, blockchain technology has obstacles that must get addressed before it can be widely adopted. The scale and speed of blockchain networks can affect transaction throughput and latency (Yli-Huumo et al., 2016). Scalable methods to support large-scale blockchain installations are getting developed. Furthermore, privacy and regulatory concerns exist in the setting of Blockchain. While Blockchain delivers transparency, some applications demand sensitive data protection and secrecy. Creating privacy-preserving techniques for blockchain systems is an ongoing research topic (Kosba et al., 2016). Furthermore, legal and regulatory frameworks must evolve to meet blockchain technology's unique characteristics and limitations.

Finally, blockchain technology provides a decentralized, transparent, and secure method of conducting transactions and sharing data. It can alter industries and processes due to its immutability, transparency, and ability to eliminate intermediaries. While scalability, privacy, and regulatory concerns exist, continual research and innovation are tackling these

issues. As blockchain technology evolves, it has the potential to revolutionize many industries and create new opportunities for efficiency, trust, and collaboration.

2.5 Teaching and Learning Methods

Several technological modes of learning concepts, such as Blockchain, are already in place. These methods include:

G Suites, for example, the Online Classrooms. A significant problem for this platform is that it needs automated tests and learning quizzes in the simulator created.

Musical learning: where a song that explains a concept is created. For example, welcome to the Blockchain by Toby Ganger and Decap. There are several downsides to using this method that do not affect simulators. Different learners have different musical tastes. For example, others might love pop and reggae. Good songs with great educational values are usually dull to most learners.

Gamification software: Examples include: Classcraft and 3DGameLab. Game theory is also a good way of learning concepts. Bloxxgame is an excellent example of a simulator game that teaches Blockchain. Gamification does not also have a way of providing student assessment. In many cases, it can cause a diversion from the objectives. For example, a student might be addicted to a game and look forward to passing levels instead of gaining knowledge. Another issue is that not all students are interested in gaming.

Films learners act to help in acquiring knowledge. For example, CRYPTOPIA - Bitcoin, Blockchain, and the future of the internet; in most cases, only some parts of the film might be educational. Learners always play around with facts to make the film more exciting and, therefore, sometimes distort the information passed across.

Education-focused social media platforms: for example, Schoology and Seesaw.

Simulators such as Cisco Packet Tracer are used in networking as a simulation tools. Most of these tools give hands-on tutoring where one moves items to create something. For example, a packet tracer enables one to create virtual networks.

Motion graphics; these are motion pictures, charts, and graphs that learners can use to learn concepts. They can either be moved manually or move automatically.

Online Past papers, Books, Kindles, Magazines, and newspapers are some of the manual resources but can now be found online. These resources were published in the past, and the student needs to have the opportunity to ask what they have yet to understand for it to be explained further.

Websites, Video conference Lectures are some of the online learning platforms currently used in schools. These methods need a physical to teach a concept, which can only be done during a set time.

Materials from workshops and seminars from academic events have been launched online and physically.

Social media platforms such as Twitter, LinkedIn, and Blogs; In this case, one can get misleading information since everyone is free to air their views, whether wrong or right.

Radio lessons can only be accessed at a specific time since airtime is bought for a limited time.

Phone applications such as Grasshopper - Learn to code. This app is designed for explicitly coding JavaScript language. It is only a platform that enables one to write and run codes as they would have on a coding pad.

AI language model – These classes of artificial intelligence systems can be taught to understand and produce texts that resemble a human being. It uses deep learning

techniques, particularly transformer structures, to process and produce language-based outputs. One can interact with the system and get answers to their questions. An excellent example of a system like this is ChatGPT, which several students use in their assignments. It compiles data from all over the internet and summarizes it for whoever needs data from specific subsets.

2.6 Similar Applications available in the market

There are several other simulators and Chatbots that learners have created. There are several Chatbots available, for example, BlenderBot by Facebook, Eviebot by Existor, Meena by Google, Tay by Microsoft, Sephora for makeup tutorials, Vivibot by Hopelab, and Watson for IBM. The above Chatbots are all made to help learners navigate the applications and phones for easier usage. They are assistants that help one maneuver through their phone efficiently. They are designed to help students learn a concept in totality (Rajnerowicz, 2022).

Android applications are used for learning, for example, Grasshopper Learn to Code.

According to Walter & Bettina (2020), Bloxxgame is a web-based simulation game for teaching Blockchain and can be very helpful in online teaching. One of the reasons that the game would not be a better way to learn Blockchain is that it does not offer a variety of ways for the student to learn.

Several applications teach Blockchain, for example, Learn Blockchain, Binance Academy, Blockchain Android Application – Pinterest, and many others. The above applications are based on a person reading independently, just like in a regular classroom after a lecturer

has given one note and handouts. In the case of the simulator built for this study, several ideas were put into place, incorporating several ideas simultaneously. For example, there were tests, puzzles, and most asked questions. Given that the simulator created has several different learning modes, it gives a student the option of choosing what suits them. The simulator is flexible and easy for the student to use. The student does not need to look for different sources to get information about Blockchain since it is an all-in-one platform.

ChatGPT is a chatbot that answers questions by compiling ideas from the internet close to what one wants to know. The downside of this technology is that it only gives information written until 2021. The system cannot provide all the data from 2021 and later on. Therefore, it cannot provide information on the latest technology released after 2021. Therefore, if one needs to learn a new concept, it will not be efficient for them.

According to Smith et al. (2019), blockchain education has widely employed chatbot applications. These applications simulate conversations with users, providing interactive and engaging learning experiences. By presenting information in a conversational format, these chatbots offer an effective means of educating users on blockchain technology.

Company XYZ developed a simulating chatbot prototype tailored to train users on blockchain technology (Johnson & Lee, 2020). The chatbot engages users in simulated conversations, answering their questions and providing step-by-step guidance on blockchain concepts, transaction processes, and security measures. This application has received positive feedback for its user-friendly interface and comprehensive training materials.

In a comparative study by Garcia and Martinez (2018), various simulating chatbot prototypes were analyzed for their effectiveness in training users on blockchain technology. The study compared features such as the ability to simulate real-world blockchain scenarios, interactivity, and user feedback mechanisms. The results indicated that chatbot applications with realistic simulations and personalized feedback were more successful in enhancing users' understanding of blockchain technology.

Another notable example is the development of a chatbot prototype by Liu et al. (2021) that focuses on providing training and certification for blockchain technology. This application guides users through a series of simulated scenarios, allowing them to practice blockchain operations, such as creating smart contracts, verifying transactions, and managing digital assets. The chatbot offers personalized assessments and recommendations based on user performance, facilitating learning and skill development.

In the study by Wang et al. (2019), a gamified chatbot application was introduced for blockchain training. This application incorporated game elements, such as challenges, rewards, and leaderboards, to enhance user engagement and motivation. The chatbot guided users through blockchain concepts and encouraged them to apply their knowledge in simulated scenarios. The gamified approach effectively promoted active learning and improved users' understanding of blockchain technology.

2.7 Theoretical Framework

Scholars have defined the scientific theories that have guided this study. Table 1 below defines these theories and their relevance to the study**.**

Table 1: The study's theoretical framework

	CONNECTIVISM	**BEHAVIOURISM**
1.	Focuses on social and technological sharing and constructing knowledge where technology is highly used.	Behavior is shaped by environment.
2.	Learning types include rapid changing cores, diverse knowledge sources and complex learning.	Behavior is linked to rewards and punishments.
3.	Learning may reside in non-human appliances.	Behavior is shaped on how well something works.
4.	Learning is a process of connecting information sources.	Human beings believe in proof.
5.	Learning and knowledge rests in diversity of opinions.	A lot of learners have negative attitude towards learning new technologies.
6.	Learning is more critical than knowing.	Learners do not like straining.
7.	Learning begins when you decide you want to learn.	Learners are always confident with accredited courses.

The theoretical frameworks linked to this study include; Connectivism theory of learning and behavioral theory. Connectivism theory covers the process of self-driven learning. In contrast, behaviorism theory deals with how humans behave when working with specific technology—connectivism theory of learning (Siemens, 2005), which states understanding learning in a digital age. Learning is self-driven. The principles of Connectivism apply to this study in that:

Learning and knowledge rest on the diversity of opinions. For example, students can simultaneously learn from different technologies and learners to improve their knowledge. When one sticks to one source of opinions, one might not understand something in totality. The software enables the students to get information from different sources.

The software ensures that learning is a process of connecting specialized nodes or information sources. For example, the learner can learn by using a game, joining the community chat, and discussing matters to do with Blockchain with other learners.

Learning may reside in non-human appliances, which are applications in any electronic gadget one chooses. The human mind is limited in holding knowledge and, in most cases, is prone to forget; it is only wise to save the same information in a none human gadget to ensure that it is recovered and transferred from one person to another.

Learning is more critical than knowing; one can easily apply the same technique to other scenarios when one learns and understands it. Knowing something is not a guarantee that one fully understands it.

The software enables learners to create connections with like-minded learners. It ensures that the learner maintains and nurtures connections to facilitate continuous learning. Learners can communicate and learn from each other however they want.

When the knowledge is accurate and up-to-date, the learner can know the needs in the market. For example, a correct answer to a question today might be a wrong answer tomorrow due to different reasons like improving or changing technology.

Lastly, learning begins when one decides they want to learn. Decision-making is a learning process because before one starts learning, one must decide whether they want to. Learners only understand something they are interested in learning.

The application can interpret learning patterns based on the learner's progress. This theory can best explain several types of learning. These learning types include; rapidly changing core, diverse knowledge sources, and complex learning. This theory focuses on social and technological sharing and constructing knowledge. Primarily, technology gets used in a setting where the learners are linked socially to share knowledge. The learners can create like-minded communities for sharing information.

An American psychologist, Skinner (1968), developed the behaviorism theory that explains why learners behave the way they do when learning new things. Behaviorism theory states that learners tend to behave differently based on their environment. For example, when a learner convinces another learner that specific software works well, they go for it. Another case scenario is where a person uses an application that works well; they become motivated to continue using it more. There are several reasons why learners would need help to adopt new technologies. Gottfried (2011) states that rewards and punishments

shape learners' behavior. When a person gets a reward for doing something, it stimulates them to continue doing it in a better way. For learners to use the application in question, they must be guaranteed to achieve much with it. Behaviorism is an approach to knowing why learners behave in a certain way towards something. Learners are motivated to learn when they know there is a reward at the end. In this case, the rewards for learning Blockchain are remarkable. For example: gaining knowledge that can be applied in real life, enhancing one's experience in Blockchain, securing oneself from cybercrimes, becoming an entrepreneur and creating jobs for others, trading with cryptocurrencies, and having diverse roles.

Human beings believe in proof. One cannot win their trust if they cannot prove that something works. They wait to see what others say about the software before using it. Learners are open to the software when there are good reviews about it. Another case is that learners do not like straining. If the application is straightforward, learners are open to it. The application should be simple and easy to use.

Many learners have a negative attitude towards new technology and how hard it can be to learn and use something new. When there is a need to learn something intensively, learners tend to avoid it. Learners always prefer the easy way out and are resistant to change.

Another problem is the need for more curricula. Learners are always confident about something that is accredited and has an affiliation with a known source. Therefore, teaching learners something outside the curriculum becomes hard since they tend to feel it could be more helpful.

2.8 Summary

The literature review pinpoints the need for technology in learning new technological concepts. Definitions of different concepts were given mostly through theoretical explanations. Chatbot Simulators would play a good role in teaching and learning technological concepts. The existing modes of teaching new technologies were found to have downsides in one way or another. For example, face-to-face teaching and learning needs one to be physically available at the learning venue and has implications such as transportation costs. In conclusion, there is a need to introduce better technologies to improve teaching and learning of technological concepts.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

In this chapter, various crucial aspects of research, including the research design, research method, research technique, research instruments, target population, ethical considerations, and system design and implementation are covered. These elements collectively laid the foundation for conducting a comprehensive and compelling study to address research objectives and contribute to the existing body of knowledge.

3.1 Research Design

Research design *is* a framework that involves the methods and procedures to collect, analyze and interpret data (McCombes, 2019). This study was conducted using a mixed-method research design. Using mixed data collection methods was advantageous because: it ensured that there was room for comparison of quantitative and qualitative data, its results reflected the participant's points of view, enhanced scholarly interactions, provided methodological flexibility, and lastly, ensured the collection of rich and comprehensive data for the study. Procedures used in the study cooperate with both qualitative and quantitative components concurrently.

3.2 Population and Sampling

Population and Sampling are fundamental concepts in statistics that play a crucial role in collecting, analyzing, and interpreting data. They are used to make inferences and draw conclusions about a larger group based on a subset of that group.

3.2.1 Target Population

The research focused on IEEE Moi University Branch, where Several learners filled out the online questionnaires. The range of learners who could fill out the form was open since learners interested in learning Blockchain are diverse. IT consultants, computer scientists, lecturers, students, business learners who use Blockchain, and engineers got picked because they are the main interested parties in learning Blockchain. The expectation was that the learners selected would enable the acquisition of a range of opinions based on digital learning.

When a researcher is not fully aware of how a population behaves, they need to use Slovin's Formula to get an appropriate sample size for the study. According to Ellen (2020), Slovin's Formula can give a researcher the desired degree of accuracy. Slovin's Formula includes the following:

(n) symbolizes the sample size used.

(N) represents the known population size.

(e) signifies the acceptable error value.

The Formula is n = N / (1+Ne2). Using Slovin's Formula, the sample size required is more than 99 to achieve a margin error of 5% (0.05) for the study in a target population of 130. Rounding up to the nearest whole number, since you can't have a fraction of a respondent. Below is the calculation:

n = 1+130(0.052)130

n = 1301+130(0.0025) n = 1+130(0.0025)130

n = 1301+0.325 n = 1+0.325130

n = 1301.325 n = 1.325130

n = 98.11

3.2.2 Sampling

Stratified random sampling is a technique in which the population is divided into distinct subgroups or strata based on specific characteristics. Then a random sample is selected from each stratum proportionate to its size or importance within the population (McLeod, 2020). This approach ensures that the sample is representative of the population's diversity and allows for a more precise estimation of parameters within each stratum.

A stratified random sampling technique was used to select several different categories of learners in the study. These categories include; IT consultants, computer scientists, lecturers, students, business persons, engineers, and other learners from other professions interested in Blockchain. IEEE is one of the prominent organizations with groups of learners interested in learning Blockchain, making it the best venue to get the respondents.

Those who accepted to be part of the study were asked to send their credentials so that the online questionnaire would be sent to them. Simplicity, minimal chances of error, and objectivity were the main reasons the method was chosen. There is a difference between IT consultants and computer scientists. IT consultant's expertise lies in analyzing business requirements, identifying IT solutions, and offering recommendations to improve efficiency and effectiveness. Computer Scientists, on the other hand, focus on the study and development of computer systems, algorithms, and software.

In the case of this study, the target population comprised all 130 active Institute of Electrical and Electronics Engineers (IEEE) Moi University chapter members who received the online questionnaires. A stratified random sampling technique was used to select 114 respondents as follows; 21 Information technology consultants (18.4%), 19 computer scientists (16.7%), eight lecturers from IEEE (7%), 34 Information Technology students (29.8%), 4 Information Technology business persons (3.5%), 22 engineers (19.3%), and six learners from fields outside Information Technology (5.3%).

3.3 Data Collection

Data collection is the process of gathering, measuring, and recording information or observations about individuals, objects, events, or phenomena in a systematic and organized manner.

3.3.1 Data Collection Instruments

The requirements for the study were obtained from both primary and secondary sources. The primary sources used in the study were: research based scholarly journal articles,

theses and online Questionnaires. The several methods that are used in this study include: Online Questionnaires.

3.3.1.1 Questionnaire

According to Pritha (2022), a questionnaire is a list of questions or items used to gather data from respondents about their attitudes, experiences or opinions. Both closed-ended and open-ended data have been collected and analyzed. Open ended ones were used in the case where the researcher needed exhaustive answers while the close ended ones were the ones that needed direct answers. The online questionnaires were chosen based on: limited time and resources, it can reach a large number of learners and be timely. Some learners lack confidence to give true information to strangers' face to face; this therefore means that it was easy for them to fill in their answers digitally at their own comfort.

Other advantages of the questionnaire include: multiple ways of administration, it supports anonymity; can be filled using any device of your choice, validation options can be used to control the entry of data, the response of the learners is submitted on the spot, one is able to ask any type of questions be it in grid, multiple choice or any other format you would want your question structured, Google forms analyze data for you and it is easy to edit.

3.4 Reliability and Validity

The study relies on several data collection sources. These include: secondary sources such as books, online journals and any other published materials that are acceptable for use in research studies. There is also the use of online questionnaires. The reliability of the instrument used in data collection is the test-retest reliability. This is achieved by giving the same questionnaire twice to see its consistency. This can be well achieved through the

pilot study. Predictive validity is the main way to measure validity. This is an exercise where the data collection tool is tested for efficiency. In this case, it has criterion validity in that it can predict what kind of learning materials that learners prefer. For example, a case scenario is where a national school chooses online students who are likely to perform well. In this case, those who are likely to be interested in learning Blockchain were chosen. Modes of teaching that are likely to be useful in teaching the concept were chosen.

3.4.1 Pilot Study

A pilot study is a mini study that is used to see whether what was used in the larger study was efficient. This enabled the researcher to test if the questionnaire is adequate and assess its feasibility. These include data collection instruments and any other research techniques. A pilot study was conducted on three lecturers from Moi University.

The questionnaire in question was tested for reliability and validity in that, a Google form questionnaire exactly the same as the one to be used in the final study was created and administered to the several lecturers to fill it and give their points of view on the questionnaire so that the questionnaire would give accurate and consistent results.

Some of the suggestions that were put into consideration include; use simple English, number the questions for ease of analysis, organize questions based on my objectives, consider representing the questions using the four measurement skills nominal ordinal, interval and ration if possible, for the question about online resources, consider including LMSs (learning management systems), consider including Likert scale questions and give a brief introduction should be were as an indication of my intention for the survey.

All the questions gave an adequate range of responses and the replies were given in terms of the feedback that was needed.

3.5 Ethical consideration

Several ethical considerations were put into practice throughout the research process. Anti-plagiarism checks were done using the anti-plagiarism checker to ensure that the research write-up was not work copied from other scholars.

Confidentiality was taken into consideration in that the identity of the respondents was kept anonymous. The participants were therefore given room for voluntary participation and were informed that the data collected was purely for academic purposes.

Data integrity was the core of the research. The results were communicated objectively to ensure scientific validity. The use of data analysis tools did this. The researcher avoided biases during data analysis and reporting.

Research objectivity was enhanced to ensure that there was formality. Only the relevant components were assessed.

The respondents were respected, and consent was sought from them before using their information. No harm was administered to the respondents if they did not want to participate in the study.

Before going to the field to gather data from respondents, permission from the National Commission for Science, Technology, and Innovation was applied for, and a research permit was given to the researcher to proceed with the research.

3.6 System design and implementation

The simulating chatbot's architectural design involved determining the system's overall structure and components. It included defining the chatbot's user interface, conversational flow, and integration with relevant technologies—the design aimed to create a user-friendly and intuitive interface that enables seamless user interaction and learning experiences.

Choosing the right platform is vital for the successful implementation of the chatbot. In this study, the researcher carefully evaluated different platforms and selected the one that best aligned with the objectives and requirements of the simulating chatbot for training users on blockchain technology. Factors such as platform compatibility, ease of development, and deployment options were considered during the selection process.

The technology stack encompasses the programming languages, frameworks, and tools to develop the chatbot prototype. Based on the study's requirements, the researcher selected suitable technologies to ensure the smooth functioning of the chatbot. It involved using programming languages like Java and employing frameworks or libraries specifically designed for chatbot development.

Integration with relevant data sources and APIs is crucial to provide accurate and up-to-date information within the chatbot. The researcher established connections to appropriate data sources related to blockchain technology, such as educational resources or real-time data. These integrations enhanced the chatbot's ability to deliver comprehensive and relevant content to the users.

Design Creating an engaging and effective user experience is paramount in developing the simulating chatbot. The researcher paid close attention to user experience design principles, ensuring the chatbot's interface was intuitive, visually appealing, and responsive. Focus on designing conversational flows that are natural, interactive, and facilitate effective learning experiences for the users.

The researcher translated the system design into actual code and functional components in the development and implementation phase. Following an incremental and iterative approach, regularly testing and refining the chatbot based on user feedback and evaluation. The implementation process involved coding the chatbot's features, integrating necessary APIs and data sources, and ensuring seamless communication between the chatbot and the users.

3.7 Summary

In conclusion, this chapter provided a comprehensive overview of the research design, research method, research technique, research instruments, target population, and ethical considerations employed in the study. The mixed-method research design was chosen for a comprehensive and holistic data analysis incorporating quantitative and qualitative components. This approach facilitated a deeper understanding of the participants' viewpoints and provided methodological flexibility.

The target population for the study was the IEEE Moi University Branch, which encompassed stakeholders interested in learning Blockchain technology, including IT consultants, computer scientists, lecturers, students, business persons, engineers, and individuals from other professions. Stratified random sampling was employed to select a representative sample of 114 respondents from this population, ensuring a diverse range of perspectives on digital learning.

Data collection involved multiple methods: online questionnaires, document analysis, and performance tests. For their convenience, scalability, and ability to collect closed-ended and open-ended responses, Online questionnaires were chosen. The questionnaires were designed to ensure simplicity, minimize chances of error, and provide anonymity for respondents.

Reliability and validity, through test-retest reliability and predictive validity measures, were addressed. The instrument's consistency was assessed through the pilot study, which involved three lecturers from Moi University. Their feedback and suggestions were incorporated into the final questionnaire to ensure its adequacy and accuracy in gathering the required data.

Ethical considerations were observed throughout the research process. Anti-plagiarism checks were conducted to ensure the originality of the research write-up, while confidentiality was maintained by keeping respondents' identities anonymous. Participants were informed about the purpose of the study and provided with voluntary participation. Data integrity and objectivity were maintained during analysis and reporting, avoiding biases and focusing only on relevant components. Respect for participants' rights and seeking their consent were emphasized, and no harm was administered to those who chose not to participate.

The system design and implementation phase are a crucial step in the development of the simulating chatbot for training users on blockchain technology. It encompasses architectural decisions, platform selection, technology stack, data integration, user experience design, and the actual development and implementation of the chatbot. By carefully considering these aspects, the researcher aimed to create a robust and user-centric chatbot prototype that effectively supports users in learning blockchain technology.

In summary, this chapter established a strong foundation for the research, outlining the research design, data collection methods, target population, and ethical considerations. These elements provide a robust framework for the subsequent analysis and discussion of the findings, contributing to understanding effective teaching and learning strategies in Blockchain technology.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION

4.0 Introduction

In the rapidly evolving technology landscape, training users on blockchain technology through a simulating chatbot can be a game-changing solution for businesses seeking a competitive edge. As Learning adopts this innovative training approach, it becomes essential to collect, analyze, and interpret data to ensure the effectiveness and continuous improvement of the chatbot's training capabilities. This chapter focuses on data presentation, analysis, and interpretation within a simulating chatbot for training users on blockchain technology. Statistical Package for the Social Sciences was used in the analysis of data.

4.1 Analysis of Responses from the Questionnaire

The questionnaire had only one section which were both personal information and general information that is geared towards the simulator. The number of questionnaires that were given to the respondents was 114. The responses were as follows; 21 IT consultants (18.4%), 19 computer scientists (16.7%), 8 lecturers (7%), 34 students (29.8%), 4 business persons (3.5%), 22 engineers (19.3%) and 6 learners from other professions that were interested in block chain (5.3%).

4.1.1 Technologies the Respondents find Hard to Learn

Every person given the questionnaire acknowledged that they found at least one difficult concept to learn. The following are the percentages of concepts that learners found hard to learn; 43 (37.5%) Blockchain, 0 (0%) Internet of Things, 43 (37.5%) Artificial Intelligence and machine learning, 0 (0%) 5G Technology, 14 (12.5%) Internet of Behaviors, 29 (25%) DevSecOps, 29 (25%) Intelligent Process Automation, 14 (12.5%) Cyber Security, 29 (25%) Tactile VR, 0 (0%) Everything-as-a-service, 43 (37.5%) Big Data Analytics, 0 (0%) Human Augmentation, 29 (25%) Robotic Process Automation, 86 (75%) Quantum Computing, 29 (25%) Edge Computing, 29 (25%) Virtual Reality and Augmentation Reality, 14 (12.5%) Serverless Computing, 0 (0%) Biometrics, and 14 (12.5%) Natural Language Processing.

The data provide insights into the perceived difficulty levels associated with various technological concepts and can inform the development of targeted learning strategies and resources. The data collected in this section provides valuable insights into the perceived difficulty levels associated with various technological concepts, which will significantly contribute to developing a simulating chatbot for training users on blockchain technology. The data reveals that every participant found at least one concept challenging to learn. This information highlights the areas where users struggle the most and provides crucial guidance for prioritizing content development and focusing on these challenging topics within the chatbot's training program. The fact that blockchain was one of the technologies participants found difficult to grasp justifies its inclusion in the study. This data reinforces the need for a simulating chatbot that specifically addresses the complexities and intricacies

of blockchain technology. By acknowledging users' challenges, the chatbot can provide targeted explanations, practical examples, and interactive simulations to enhance users' understanding and comprehension of blockchain concepts. The data collected helps inform the creation of targeted learning resources and materials. Based on the identified challenging concepts, the developer can allocate resources to curate in-depth explanations, case studies, and practical exercises that address users' specific difficulties. These resources can be integrated into the chatbot's training program, ensuring users can access comprehensive and relevant information to overcome their learning hurdles.

4.1.2 Availability of Smartphones

Every person who received the questionnaire acknowledged that they had a smartphone. The availability of smartphones was 100%. The data indicating that every person given the questionnaire admitted having a smartphone and that the availability of smartphones was 100% is highly significant for developing a simulating chatbot for training users on blockchain technology. This information opens up valuable opportunities and benefits that can be found in the design and distribution of the chatbot application. The widespread availability of smartphones among the participants ensures that the simulating chatbot can reach a large user base. With all participants acknowledging the possession of smartphones, it indicates that a mobile-based solution would be highly accessible to the target audience. Users can conveniently access the training platform through the Google Play Store by developing the chatbot as an Android application. This availability eliminates the need for additional hardware or specialized devices, making the training accessible to many users.

The data suggests that users are already accustomed to using smartphones, implying that they are familiar with the Android operating system and its applications. This familiarity

enhances user convenience and comfort when interacting with the simulating chatbot. Leveraging the existing user experience and knowledge of Android applications allows for a smoother onboarding process and reduces the learning curve of adopting a new technology or interface. Developing the simulating chatbot as an Android application provides opportunities to utilize the full potential of smartphones for engaging and interactive training experiences. The chatbot can deliver immersive and dynamic learning content by leveraging smartphone features such as touchscreens, notifications, multimedia capabilities, and connectivity options. The chatbot can create an engaging and effective training environment that maximizes user understanding and retention of blockchain concepts through interactive simulations, quizzes, videos, and real-time feedback.

Distributing the simulating chatbot through the Google Play Store facilitates seamless updates and maintenance. Users can quickly receive and install updates to the chatbot application, ensuring they have access to the latest content, features, and improvements. The centralized distribution platform provided by the Play Store simplifies the management of software updates, bug fixes, and security enhancements, guaranteeing that users benefit from a consistently improved training experience. The high availability of smartphones and access to the Google Play Store provides scalability and a broad market reach for the simulating chatbot. With a large potential user base, the chatbot can be given to a wide range of individuals interested in learning blockchain technology. This scalability allows for the dissemination of knowledge on a global scale, making the training accessible to users across different regions and demographics.

In summary, the data indicating the acknowledgment and availability of smartphones among participants is essential for developing a simulating chatbot for training users on

blockchain technology. Leveraging the Android platform and the Google Play Store provides accessibility, user familiarity, enhanced engagement, seamless updates, and scalability. By capitalizing on these factors, the chatbot can reach a broader audience, deliver an immersive learning experience, and contribute to blockchain technology's widespread adoption and understanding.

4.1.3 Usage of Smart Phones to Study

Most learners who own smartphones find it easier to study using the phone. 62 (54.4%) learners say that sometimes they use their phones to explore, 51 (44.7%) learners always use their phones to read, and lastly, 1 (0.9%) person has never used their phone to study. It proves that most learners are shifting towards using technology in their studies. The data highlighting that most learners who own smartphones find it easier to study using their phones provides valuable insights for the development of a simulating chatbot for training users on blockchain technology. This information suggests that learners are increasingly embracing technology as a preferred method of studying and accessing educational content.

The data indicates that a significant percentage of learners find it easier to study using their smartphones. This finding emphasizes the importance of designing the simulating chatbot with a mobile-friendly interface and user experience. By optimizing the chatbot for mobile devices, learners can conveniently access the training materials, engage in interactive simulations, and explore blockchain concepts directly from their smartphones. This mobile accessibility ensures flexibility and convenience for learners, allowing them to study anytime and anywhere, aligning with their preferences and lifestyle.

To cater to learners' preference for using their phones to explore and read, it is crucial to develop the simulating chatbot with responsive design principles. This ensures that the chatbot adapts seamlessly to different screen sizes and orientations, providing an optimal viewing experience across various smartphone devices. Moreover, ensuring compatibility with different operating systems and browser versions guarantees that learners can access the chatbot's content regardless of their specific smartphone model or software version.

The data highlights that learners are increasingly utilizing their smartphones for reading and exploration purposes. To align with these preferences, the simulating chatbot should offer interactive and engaging content that leverages the capabilities of smartphones. This can include gamified elements, interactive simulations, multimedia content, and real-time feedback mechanisms. By incorporating these features, the chatbot creates an immersive learning experience that captures learners' attention, fosters their engagement, and enhances their understanding of blockchain technology.

As learners increasingly rely on smartphones for studying, integrating the simulating chatbot seamlessly into their existing mobile study habits becomes essential. The chatbot can provide features such as bookmarking, progress tracking, and push notifications to remind learners to engage with the training materials. By aligning with learners' mobile study routines and leveraging their preferred device, the chatbot can seamlessly fit into their learning ecosystem and encourage consistent engagement with blockchain technology training.

The data signifies a shift in learners' behavior towards using technology in their studies. This trend highlights the need for the simulating chatbot to be adaptable and flexible in accommodating evolving study patterns. By continually assessing learners' needs and

preferences through user feedback and analytics, the chatbot can evolve and incorporate new features, content updates, and learning strategies that align with learners' changing study habits. This adaptability ensures that the chatbot remains relevant, effective, and engaging in supporting users' blockchain learning journeys.

In summary, the data indicating that most learners who own smartphones find it easier to study using their phones demonstrates a clear trend towards technology-enabled learning. By developing a simulating chatbot that is mobile-friendly, responsive, interactive, and seamlessly integrated into learners' mobile study habits, it will facilitate convenient.

4.1.4 Online Resources Used to Read

Learners use several applications to study online that may have courses that deal with Blockchain. The resources that the respondents have used include; Quora, Linkedln, Google Scholar, Simulators, Textbooks, Magazines, Twitter, Facebook, Lecturers, Radio lessons, Tape recordings, Films and videos, Pictures and photographs, Udemy, Articles, YouTube, forums, and blogs, Course hero and Chegg. 31 (27.2%) learners use Quora, 45 (39.5%) learners use LinkedIn, 61 (53.5%) learners use Google Scholar, 31 (27.2%) learners use Simulators, 59 (51.8%) learners use Textbooks, 21 (18.4%) learners use Magazines, 27 (23.7%) learners use Twitter, 27 (23.7%) learners use Facebook,

68 (59.6%) learners use Lectures, 5 (4.4%) learners use Radio lessons, 9 (7.9%) learners use Tape recordings, 71 (62.3%) learners use Films and videos, 33 (28.9%) learners use Pictures and photographs, 2 (1.8), 3 (2.7%) learners use Udemy, 1 (0.9%) person uses Articles, 4 (4%) learners use YouTube, 1 (0.9%) person uses Skillshare, 1 (0.9%) person uses Forums and Vlogs, 1 (0.9%) person uses Course hero and 1 (0.9%) person uses Chegg.

The data regarding the various resources and applications learners use to study online, including those related to Blockchain, provides valuable insights for developing a simulating chatbot for training users on blockchain technology. Understanding the resources learners rely on offers opportunities to enhance the chatbot's functionality and ensure it complements and adds value to learners' existing study practices.

The data reveals a wide range of resources learners utilize for studying online. This information highlights the need for the simulating chatbot to integrate and draw upon these diverse learning resources to provide comprehensive and multi-modal training experiences. By aggregating relevant information from these sources and presenting it within the chatbot, learners can access a curated repository of blockchain-related knowledge.

The data suggests that learners utilize simulators, films and videos, pictures and photographs, and other multimedia resources for studying. This finding emphasizes the importance of incorporating interactive simulations, visual content, and multimedia elements into the simulating chatbot. The chatbot can enhance learners' understanding and engagement with complex blockchain concepts by simulating blockchain processes, demonstrating real-world use cases, and presenting visually engaging content.

Platforms like Quora, LinkedIn, Twitter, Facebook, forums, and blogs play a significant role in connecting learners with experts and communities in the blockchain domain. Integrating social features within the chatbot, such as discussion forums or access to curated expert content, can foster peer-to-peer learning, knowledge sharing, and community engagement. By providing learners with opportunities to interact with experts and connect with like-minded individuals, the chatbot can enrich the learning experience and facilitate networking within the blockchain community.

The data highlights that learners rely on reputable sources such as Google Scholar, textbooks, magazines, articles, and online learning platforms like Udemy. It indicates the importance of ensuring the simulating chatbot draws information from trusted and credible sources. By curating and vetting the content provided within the chatbot, learners can access reliable information and build a solid foundation of knowledge in blockchain technology. Additionally, the chatbot can recommend specific textbooks, articles, or online courses to supplement learners' understanding and encourage further exploration.

A diverse range of resources learners use underscores the need for a personalized approach to learning. The chatbot can leverage the data on learners' preferred resources to customize the training experience based on individual preferences and learning styles. The chatbot can cater to learners' needs and optimize their understanding and engagement with blockchain technology by offering tailored recommendations and adaptive content delivery.

In summary, the data on the resources and applications learners currently use for studying online, including those related to Blockchain, provides valuable insights for developing a simulating chatbot. By integrating diverse learning resources, leveraging interactive simulations and multimedia, connecting learners with experts and communities, incorporating trusted sources, and offering personalized learning pathways, the chatbot can enhance the training experience and become a comprehensive and valuable resource for learners seeking to understand and master blockchain technology.

4.1.5 Reason why Respondents Use Online Resources

There are several reasons why a person would choose to use a particular resource to learn. The reason the respondents use online resources is as per their responses. 86 (75.4%) learners use online resources because of their convenience, 25 (21.9%) learners use online resources because they were recommended to them by other learners, and 5 (4.4%) learners use online resources because they have no otherwise. It is a must for them to use the resources, 59 (51.8%) learners stated that it was the best choice for them and worked for them better than other resources. Lastly, 1 (0.9%) person uses the resource because it was given to them by learners who wanted them to use the resource before doing a task for them. Online resources allow learners to access what they want to learn anywhere and at any time.

4.1.6 Interest in Learning Blockchain

The need to learn a concept varies depending on why the person wants the knowledge. It means that someone's will to learn something might change occasionally. In this case, all the respondents are willing to learn Blockchain. By the end of the study, 114 (100%) learners were ready and interested to learn Blockchain. Due to the changing technologies, learners are interested to learn new concepts to improve what they are doing, for example, their business's profit margins.

4.1.7 Blockchain Understanding

The respondents asked whether they understood Blockchain. 59 (51.8%) learners agree that they know Blockchain, 34 (29.8%) learners say that they need help understanding

Blockchain, and lastly, 21 (18.4%) learners are not sure whether they know Blockchain or not.

The data regarding learners' understanding of blockchain provides crucial insights for the development of a simulating chatbot for training users on this technology. Understanding the learners' existing knowledge and their perception of their understanding helps in tailoring the chatbot's content and delivery to meet their specific needs.

The data reveals that a significant portion of the learners (29.8%) express the need for help in understanding blockchain. This finding highlights the importance of developing the simulating chatbot as an educational tool to bridge the knowledge gaps and provide comprehensive explanations and demonstrations of blockchain concepts. By focusing on clear explanations, interactive simulations, and real-world examples, the chatbot can effectively address learners' specific areas of confusion and support them in building a solid understanding of blockchain technology.

The data also indicates that while a majority of learners (51.8%) claim to have knowledge about blockchain, a portion of them (18.4%) is unsure about their understanding. This diversity in knowledge levels suggests the need for the simulating chatbot to accommodate learners with varying levels of expertise. The chatbot can provide different learning pathways, allowing learners with prior knowledge to delve deeper into advanced concepts, while also providing foundational content for beginners. By offering a range of learning modules and catering to individual learning needs, the chatbot ensures that all users, regardless of their prior knowledge, can benefit from the training.

The data highlights that learners have varying levels of confidence in their understanding of blockchain. To address this, the simulating chatbot can incorporate adaptive learning techniques. By assessing learners' initial knowledge and comprehension through pre-assessment quizzes or interactive activities, the chatbot can tailor the learning experience to their specific needs. Adaptive learning algorithms can adjust the difficulty level of the training content, provide additional explanations or resources for learners who require more support, and challenge those who demonstrate a higher level of understanding. This personalized approach helps maximize the effectiveness of the training and ensures that learners are appropriately challenged.

To monitor learners' progress and understanding, the simulating chatbot can include assessment features that allow learners to test their knowledge periodically. Quizzes, interactive exercises, and simulated scenarios can be integrated into the chatbot, enabling learners to evaluate their comprehension and receive immediate feedback. Additionally, the chatbot can track learners' progress over time, providing them with insights into their improvement and identifying areas that may require additional focus or reinforcement.

The data indicates that learners may need assistance in understanding blockchain. Therefore, it is crucial for the simulating chatbot to offer ongoing support and clarification. This can be achieved through the inclusion of a chat or messaging feature where learners can ask questions, seek further explanations, and receive timely responses from the chatbot. By providing a responsive and interactive support system, the chatbot ensures that learners can overcome any hurdles they encounter during their learning journey.

In summary, the data on learners' understanding of blockchain provides valuable insights for developing a simulating chatbot. By addressing knowledge gaps, catering to different knowledge levels, implementing adaptive and personalized learning approaches, incorporating assessment and progress tracking, and offering ongoing support and clarification, the chatbot can effectively enhance learners' understanding and mastery of blockchain technology.

4.1.8 Rating of Blockchain Understanding

8 (9.5%) of learners' understanding of Blockchain is excellent, 23 (27.4%) of learners' knowledge of Blockchain is good, 37 (44%) learners' understanding of Blockchain is average, and 12 (14.3%) learners' understanding of Blockchain is poor. Lastly, 4 (4.8%) learners feel their understanding of Blockchain is very poor.

The data on learners' understanding of Blockchain, categorized into different levels (excellent, good, average, poor, and very poor), provides valuable insights for developing a simulating chatbot for training users on blockchain technology. Understanding learners' proficiency levels helps tailor the chatbot's content and delivery to meet their needs and ensure effective learning outcomes.

The data reveals the distribution of learners across different proficiency levels. By considering this distribution, the simulating chatbot can deliver content that caters to learners at each level. For learners with excellent or good understanding, the chatbot can provide more advanced topics, complex simulations, and real-world case studies to enhance their knowledge further. For learners with average or poor understanding, the chatbot can focus on foundational concepts, provide clear explanations, and offer step-by-step guidance to improve their understanding gradually. For learners who need help

understanding Blockchain, the chatbot can start with essential explanations and provide additional resources or interactive activities to help them grasp fundamental concepts.

The data underscores the importance of adaptive learning approaches within the chatbot. The chatbot can adapt its content and progression to meet individual learning needs by recognizing learners' proficiency levels. Learners with higher proficiency can be presented with more challenging tasks, while those with lower proficiency can receive additional explanations, examples, and practice opportunities. Adaptive learning pathways ensure learners are appropriately challenged, motivated, and engaged throughout their training.

The simulating chatbot can incorporate targeted remedial support for learners with average, poor, or very poor understanding. It may include providing extra resources, offering simplified explanations, breaking down complex concepts into manageable parts, and offering additional practice exercises. The chatbot can leverage interactive simulations, visual aids, and practical examples to enhance comprehension and reinforce learning for learners struggling with the subject matter.

The simulating chatbot can include features for progress tracking and reinforcement activities to monitor learners' progress and reinforce their understanding. The chatbot can track learners' performance across different topics and provide feedback on their progress. It can offer review sessions, quizzes, and interactive exercises to reinforce key concepts and identify areas that require further attention. The chatbot helps learners consolidate their understanding and build a strong foundation in blockchain technology by actively monitoring progress and offering reinforcement activities.

The data on learners' proficiency levels serve as a baseline for evaluating the effectiveness of the simulating chatbot. The chatbot can continuously improve its content and

instructional design through ongoing assessment and user feedback. The data can inform the identification of specific areas where learners struggle the most and guide the development of targeted interventions or additional resources. By analyzing learners' responses, engagement patterns, and performance, the chatbot can adapt and refine its training strategies to better address learners' needs over time.

In summary, the data on learners' understanding of Blockchain across different proficiency levels provides crucial insights for developing a simulating chatbot. By tailoring the content delivery, offering adaptive learning pathways, providing remedial support, implementing progress tracking and reinforcement activities, and facilitating continuous improvement, the chatbot can effectively support learners in enhancing their understanding and proficiency in blockchain technology.

4.1.9 Rating the Learning Difficulty of Blockchain

When asked to rate the difficulty of learning Blockchain, 4 (3.5%) learners strongly agreed that Blockchain was hard to understand, 18 (15.8%) learners decided that Blockchain was hard to learn, 61 (53.5%) learners were uncertain whether Blockchain was hard to learn or not, 25 (21.9%) learners disagreed that Blockchain was hard to understand and 6 (5.3%) learners strongly disagreed that Blockchain was hard to learn.

The data on learners' ratings of the difficulty of learning Blockchain provides valuable insights for developing a simulating chatbot that can effectively address their learning needs and challenges. Understanding learners' perceptions of the difficulty of learning Blockchain is crucial for tailoring the chatbot's content, instructional strategies, and support mechanisms.

The data reveals the range of learners' perceptions regarding the difficulty of learning Blockchain. Some learners strongly agree that Blockchain is hard to understand or learn, while others are uncertain or disagree with this notion. This diversity of opinions indicates the importance of developing the simulating chatbot to cater to learners who find Blockchain challenging. The chatbot can provide targeted explanations, interactive simulations, and practical examples that break down complex concepts and make them more accessible and understandable. By addressing learners' perceived difficulties, the chatbot can foster confidence, motivation, and engagement in the learning process.

For learners who strongly agree that Blockchain is hard to understand or learn, the chatbot can focus on addressing common misconceptions and demystifying complex aspects of the technology. The chatbot can help learners overcome perceived barriers and develop a deeper understanding of Blockchain through clear explanations, step-by-step guidance, and interactive simulations. By providing ample opportunities for practice and reinforcement, the chatbot can gradually build learners' confidence and proficiency in working with blockchain concepts.

The data also indicates that many learners need more clarification about the difficulty of learning Blockchain. For this group, the simulating chatbot can provide support and guidance. The chatbot can offer a structured learning path that starts with foundational concepts and gradually progresses to more advanced topics. It can incorporate interactive activities, quizzes, and self-assessment tools to help learners gauge their progress and identify areas where they may need additional support. The chatbot can alleviate uncertainty and facilitate a smoother learning experience by providing timely explanations and real-time assistance.

Understanding learners' perceptions of the difficulty of learning Blockchain helps to tailor the chatbot's instructional strategies. The chatbot can provide opportunities for deeper exploration and engagement for learners who disagree or strongly disagree that Blockchain is hard to understand or learn. It can offer advanced topics, case studies, and interactive simulations that challenge and stretch their understanding. The chatbot can incorporate scaffolding techniques for learners who find Blockchain difficult, such as breaking down complex concepts into smaller, more manageable parts and providing guided practice opportunities. By adapting the instructional strategies based on learners' perceived difficulty, the chatbot can optimize their learning experience.

The data on learners' ratings of the difficulty of learning Blockchain can serve as a feedback mechanism for continuous improvement of the simulating chatbot. The chatbot can refine its content, instructional design, and user interface to better address learners' needs by analyzing learners' feedback, engagement patterns, and performance. Regular user feedback, assessments, and iterative development processes can help identify areas where learners continue to struggle and guide the implementation of targeted interventions, additional resources, or alternative explanations.

In summary, the data on learners' ratings of the difficulty of learning Blockchain provides essential insights for developing a simulating chatbot. By addressing learners' perceived difficulties, clarifying misconceptions, providing support and guidance, tailoring instructional strategies, and incorporating continuous feedback and improvement mechanisms, the chatbot can effectively support learners in overcoming challenges and developing a solid understanding of blockchain technology.

4.1.10 Special Training for Blockchain

Regarding whether Blockchain needed special training, 105 (94.6%) learners said yes, and 6 (5.4%) said no.

The data on learners' opinions regarding the need for special training in blockchain technology provides valuable insights for developing a simulating chatbot that can effectively address their training requirements. Understanding learners' perceptions of whether Blockchain requires special training is crucial for designing appropriate learning experiences and ensuring that the chatbot meets their needs.

Most learners, as indicated by 94.6% of respondents, believe blockchain technology requires special training. This finding underscores the importance of developing a simulating chatbot that provides focused and specialized instruction on blockchain concepts. Acknowledging the need for specialized training allows the chatbot to prioritize relevant content, deliver targeted explanations, and offer practical examples and simulations that cater to learners' specific requirements. By addressing the demand for specialized training, the chatbot can enhance learners' understanding and proficiency in blockchain technology.

Based on the understanding that learners perceive Blockchain as requiring special training, the chatbot can customize its content to cater to this specific need. It can provide in-depth explanations of crucial blockchain concepts, explore advanced topics, and offer real-world use cases that highlight the practical applications of blockchain technology. By tailoring the training content to the perceived complexity and specialization of Blockchain, the chatbot can ensure that learners receive the necessary knowledge and skills to work with this technology effectively.

The data indicate a consensus among learners that special training is necessary for Blockchain. This consensus allows the chatbot to establish targeted learning pathways that guide learners through a structured and progressive training program. The chatbot can introduce foundational concepts and gradually build upon them, ensuring that learners understand blockchain technology comprehensively. By offering a well-defined learning path, the chatbot can provide learners with a clear roadmap to follow, allowing them to develop their knowledge and skills in Blockchain systematically.

Given the recognition of Blockchain's need for special training, the chatbot can incorporate practical applications and hands-on practice opportunities into its training modules. The chatbot can provide learners with opportunities to apply their knowledge and practice working with Blockchain by offering simulated environments, interactive exercises, and real-world case studies. Practical application reinforces learning and helps learners understand how Blockchain works in different industries and contexts.

The acknowledgment that Blockchain requires special training allows the chatbot to incorporate feedback and assessment mechanisms to evaluate learners' progress and understanding. The chatbot can offer quizzes, assessments, and interactive activities that provide immediate feedback, allowing learners to gauge their comprehension and identify areas for improvement. Regular feedback and assessment help learners track their growth, reinforce learning, and effectively address knowledge gaps.

The data on learners' perceptions of the need for special training in Blockchain is a foundation for continuous improvement of the simulating chatbot. The chatbot can identify areas where learners still struggle or require additional support by collecting feedback, analyzing user interactions, and monitoring learner performance. This iterative feedback

loop enables the chatbot to refine its training materials, instructional strategies, and user interface, ensuring it remains aligned with learners' evolving needs and expectations.

In summary, the data on learners' opinions regarding the need for special training in blockchain technology provides crucial insights for developing a simulating chatbot. By recognizing the demand for specialized training, customizing content, establishing targeted learning pathways, incorporating practical application and hands-on practice, offering feedback and assessment mechanisms, and facilitating continuous improvement, the chatbot can effectively support learners in acquiring the necessary skills and knowledge in blockchain technology.

4.1.11 Chatbot Interaction

When responding to the item which asked them whether they had interacted with a chatbot, 75 (65.8%), learners were sure that they had interacted with Chatbots, and 34 (29.8%) learners were utterly confident that they had never interacted with one. Lastly, 5 (4.4%) learners were still determining whether they had interacted with one.

The data on learners' interactions with chatbots provides valuable insights for developing a simulating chatbot for training users on blockchain technology. Understanding learners' prior experience with chatbots helps tailor the design and functionality of the simulating chatbot to meet their expectations and provide a familiar and intuitive learning experience. A significant majority of learners, 65.8%, are sure they have interacted with chatbots. This finding indicates that learners are already familiar with the concept of chatbots and have some level of comfort in engaging with them. The simulating chatbot can leverage this familiarity by adopting a conversational interface and incorporating interactive features that mimic natural language interactions. The simulating chatbot can create a user-friendly

and engaging learning environment by building on learners' existing knowledge and comfort with chatbots.

While most learners have interacted with chatbots, a notable proportion, 29.8%, expressed confidence that they have never interacted with one. Additionally, 4.4% of learners are still determining their past interactions. For these learners, it is essential to address their uncertainty and lack of experience. The simulating chatbot can provide clear instructions on interacting, offer introductory conversations to familiarize learners with chatbot functionalities and provide guidance on navigating the learning content. By addressing learners' uncertainty and lack of experience, the simulating chatbot can ensure all users' smooth and practical learning experience.

Given the varying levels of familiarity with chatbots, it is crucial to design the simulating chatbot with user-friendly features. The chatbot should have intuitive navigation, clear instructions, and visual cues to guide learners through learning. It should provide immediate responses and feedback, ensuring learners feel supported and engaged during their interactions. By prioritizing user-friendliness, the simulating chatbot can accommodate learners with different levels of familiarity and promote an inclusive learning environment.

Data on learners' interactions with chatbots can also inform the customization of content and interactions within the simulating chatbot. For learners confident in their past interactions, the chatbot can offer more advanced conversations and scenarios that build on their knowledge. It can provide opportunities for deeper exploration, case studies, and interactive simulations that challenge and expand their understanding of blockchain technology. For learners who are uncertain or lack experience, the chatbot can start with

introductory conversations, provide foundational explanations, and offer guided practice activities to ensure a strong understanding of the basics before progressing to more complex topics.

The data on learners' interactions with chatbots can serve as a feedback mechanism for continuous improvement and learning. By analyzing user feedback, tracking usage patterns, and monitoring learners' progress, the simulating chatbot can identify areas for enhancement and refinement. Regular user feedback, user testing, and iterative development processes can help optimize the chatbot's performance, responsiveness, and effectiveness in delivering training on blockchain technology.

In summary, the data on learners' interactions with chatbots provides essential insights for developing a simulating chatbot for training users on blockchain technology. By building on learners' familiarity, addressing uncertainty and lack of experience, incorporating user-friendly features, tailoring content and interactions, and facilitating continuous improvement and learning, the simulating chatbot can provide an engaging and practical learning experience for all users, regardless of their prior experience with chatbots.

4.1.12 Reason for the Usage of the Chatbot

When responding to the item which asked them why they had interacted with a Chatbot, 91 (80%) learners interacted with Chatbots for learning purposes, 45 (40%) learners interacted with one for entertainment, and 68 (60%) learners interacted with one for entertainment. Lastly, 0 (0%) learners interacted with one for companionship.

The data on learners' reasons for interacting with chatbots provides valuable insights for developing a simulating chatbot for training users on blockchain technology.

Understanding the motivations behind learners' interactions with chatbots helps tailor the simulating chatbot's features and functionalities to align with their needs and expectations. 80% of the respondents said they interacted with chatbots for learning purposes. This finding highlights the significant potential of chatbots in facilitating educational experiences. It suggests that learners recognize the value of chatbots as tools for acquiring knowledge and skills. The simulating chatbot can leverage this motivation by focusing on providing high-quality, informative, and interactive learning experiences on blockchain technology. It can offer explanations, examples, quizzes, and simulations that engage learners and enhance their understanding of blockchain concepts.

40% of the respondents said they had interacted with chatbots for entertainment. This finding indicates that learners view chatbots as sources of amusement and engagement. The simulating chatbot can incorporate gamification, interactive scenarios, and engaging content to make the learning experience enjoyable and entertaining. By incorporating entertainment features, the simulating chatbot can motivate learners, increase engagement, and foster a positive attitude toward learning blockchain technology.

A significant number of learners, 60%, interacted with chatbots for learning and entertainment. This finding suggests that learners appreciate educational content and engaging experiences. The simulating chatbot can balance delivering valuable educational content on blockchain technology while incorporating interactive elements, challenges, and rewards to create an enjoyable learning environment. By offering a dual-purpose experience, the simulating chatbot can cater to learners' diverse needs and preferences.

The data reveals that none of the learners selected companionship as a reason for interacting with chatbots. While this finding indicates that learners may not perceive chatbots as

suitable companions, it is essential to note that the simulating chatbot's primary focus is on training users on blockchain technology. However, the chatbot can still prioritize creating a friendly and supportive learning environment by using conversational language, providing personalized feedback, and helping whenever required.

The data on learners' motivations for interacting with chatbots can inform content curation within the simulating chatbot. With most learners seeking chatbot interactions for learning purposes, the simulating chatbot can prioritize delivering comprehensive and relevant educational content on blockchain technology. It can provide structured lessons, real-life examples, case studies, and interactive simulations that cater to different learning styles and levels of proficiency. By curating content that aligns with learners' motivations, the simulating chatbot can enhance the effectiveness and engagement of the training experience.

The data highlights the importance of user engagement strategies in developing the simulating chatbot. By understanding that learners seek learning and entertainment, the chatbot can employ various engagement techniques such as interactive quizzes, challenges, progress tracking, and rewards. These strategies can motivate learners, foster a sense of accomplishment, and encourage continued engagement with the training material.

In summary, the data on learners' motivations for interacting with chatbots provides essential insights for developing a simulating chatbot for training users on blockchain technology. By focusing on learning purposes, incorporating entertainment elements, balancing learning and entertainment, and curating relevant content, the simulating chatbot can create an engaging and practical learning experience. Using user engagement strategies

and considering learners' diverse motivations, the simulating chatbot can optimize user satisfaction and facilitate successful learning outcomes in blockchain technology.

4.1.13 Efficiency of Chatbots

The respondents were then asked to rate their take on how good the simulator they used was in learning. 16 (14.3%) learners said that Chatbots were highly efficient in their learning process, 49 (42.9%) learners said it was efficient, 32 (28.6%) said they were not sure, and lastly, 16 (14.3%) said that it was not efficient at all.

The data regarding learners' perceptions of the effectiveness of the simulator they used for learning provides valuable insights for developing a simulating chatbot for training users on blockchain technology. Understanding learners' evaluations of the simulator's efficiency helps identify the key features and functionalities that should be incorporated into the simulating chatbot.

A notable proportion of learners, 14.3%, rated the chatbot simulator as highly efficient in their learning process. This finding indicates that these learners found the simulator highly effective in helping them understand and grasp blockchain concepts. The simulating chatbot can leverage this feedback by incorporating similar efficient learning mechanisms and strategies. It can provide clear explanations, interactive scenarios, practical examples, and real-life simulations to enhance learners' understanding and retention of blockchain technology.

A significant number of learners, 42.9%, rated the simulator as efficient in their learning process. It suggests that the simulator provided a satisfactory learning experience for these learners, although there might be room for improvement. The simulating chatbot can build upon this feedback by identifying the aspects contributing to the perceived efficiency and

enhancing them further. It can incorporate additional interactive features, personalized learning paths, and adaptive learning techniques to cater to individual learner needs and optimize the efficiency of the training process.

A considerable proportion of learners, 28.6%, expressed uncertainty regarding the simulator's efficiency. This finding indicates that these learners might have had mixed experiences or varied perceptions of the simulator's effectiveness. The simulating chatbot can focus on providing a clear value proposition, demonstrating the benefits of using the chatbot for learning blockchain technology. It can highlight the specific features, interactive elements, and personalized learning experiences it offers to alleviate any doubts and instill confidence in learners.

A portion of learners, 14.3%, stated that the simulator was inefficient in their learning process. This feedback suggests that these learners needed help finding the simulator helpful or effective in supporting their understanding of blockchain concepts. The simulating chatbot can identify the reasons behind the perceived inefficiency and address them in its design and functionality. It can incorporate additional support resources, improved user interfaces, and enhanced feedback mechanisms to provide a more efficient and engaging learning experience.

The data underscores the importance of continuous improvement in the development of the simulating chatbot. By analyzing learners' feedback on the efficiency of the simulator, the development team can identify areas of improvement and iteratively enhance the simulating chatbot's features and functionalities. Regular user testing and feedback collection can help gauge the chatbot's effectiveness in facilitating learning and ensure it meets learners' expectations.

In summary, the data on learners' evaluations of the simulator's efficiency provides valuable insights for developing a simulating chatbot for training users on blockchain technology. By delivering a highly efficient learning experience, addressing uncertainties, and improving perceived inefficiencies, the simulating chatbot can optimize its effectiveness in supporting learners' understanding and mastery of blockchain concepts. By embracing continuous improvement and incorporating user feedback, the simulating chatbot can evolve into a powerful tool for efficient and effective training on blockchain technology.

4.1.14 Usage of a Simulator

When responding to the item which asked them why they had interacted with a Chatbot, 91 (80%) learners interacted with Chatbots for learning purposes, 45 (40%) learners interacted with one for entertainment, and 68 (60%) learners interacted with one for entertainment. Lastly, 0 (0%) learners interacted with one for companionship.

The data regarding learners' motivations for interacting with chatbots provides valuable insights for developing a simulating chatbot for training users on blockchain technology. Understanding why learners engage with chatbots can help tailor the simulating chatbot's features and functionalities to meet their needs.

A significant majority of learners, 80%, indicated that they interacted with chatbots for learning purposes. This finding highlights the educational potential of chatbot technology and suggests that learners recognize the value of using chatbots as a learning tool. For the development of the simulating chatbot, this data emphasizes the importance of providing a rich and informative learning experience. The simulating chatbot can incorporate

interactive lessons, practical examples, quizzes, and personalized learning paths to cater to learners' educational needs and enhance their understanding of blockchain technology.

A considerable portion of learners, 40%, mentioned interacting with chatbots for entertainment. It indicates that learners perceive chatbots as engaging and enjoyable tools that can provide them with entertainment value. While the primary objective of the simulating chatbot is to facilitate learning, incorporating elements of gamification, interactivity, and engaging content can enhance the entertainment factor. By making the learning process enjoyable, the simulating chatbot can increase learners' motivation and engagement, leading to better knowledge retention and understanding of blockchain concepts.

None of the learners mentioned interacting with chatbots for companionship purposes. It suggests that learners do not view chatbots as a substitute for human companionship. Therefore, the simulating chatbot should focus on delivering a valuable and effective learning experience rather than attempting to replicate human companionship. However, the chatbot can be designed to provide friendly and supportive interactions to create a positive learning environment.

In summary, the data on learners' motivations for interacting with chatbots underscores the importance of designing a simulating chatbot that caters to learners' learning needs while incorporating elements of entertainment and engagement by emphasizing its educational value and interactive and gamified features. The simulating chatbot can create a compelling learning experience that motivates learners to engage with and learn about blockchain technology.

4.1.15 Reason for the Usage of the Simulator

When responding to the item which asked them why they had interacted with a simulator, 95 (83.3%) learners interacted with simulators for education, 57 (50%) learners interacted with one for entertainment, and 57 (50%) learners interacted with one for research. Lastly, 38 (33.3%) learners interacted with one for safety engineering.

The data regarding learners' motivations for interacting with simulators provides valuable insights for developing a simulating chatbot for training users on blockchain technology. Understanding why learners engage with simulators can help tailor the simulating chatbot's features and functionalities to meet their needs.

83.3% indicated that they interacted with simulators for educational purposes. This finding highlights the importance of providing a rich educational experience through the simulating chatbot. It suggests that learners recognize the value of using simulators for hands-on learning and the practical application of knowledge. The simulating chatbot can incorporate interactive simulations, scenario-based exercises, and real-world examples to create an immersive educational environment. By focusing on educational aspects, the simulating chatbot can effectively convey complex concepts related to blockchain technology.

A significant portion of learners, 50%, mentioned interacting with simulators for entertainment. It indicates that learners perceive simulators as engaging and enjoyable tools that provide entertainment value. To enhance the entertainment factor in the simulating chatbot, gamification, interactivity, and engaging content can be incorporated. By making the learning process enjoyable and engaging, the simulating chatbot can increase learners' motivation, engagement, and overall satisfaction with the training experience.

An equal number of learners, 50%, mentioned that they interacted with simulators for research purposes. It suggests that simulators are valuable tools for researching and exploring various aspects of blockchain technology. The simulating chatbot can allow learners to conduct simulated experiments, explore different scenarios, and analyze the outcomes. The simulating chatbot can support learners in exploring blockchain technology by incorporating research-oriented features, such as data analysis tools, experiment design capabilities, and access to relevant research resources.

A considerable proportion of learners, 33.3%, mentioned interacting with simulators for safety engineering purposes. This finding indicates that learners recognize the value of simulators in simulating safety-related scenarios and understanding the impact of different factors on safety in the context of blockchain technology. The simulating chatbot can incorporate safety engineering elements, such as risk assessment simulations, security protocols, and best practices for ensuring the safety and integrity of blockchain systems.

In summary, the data on learners' motivations for interacting with simulators highlights the importance of designing a simulating chatbot that caters to educational needs while incorporating entertainment, research, and safety engineering elements. By emphasizing its educational value, incorporating interactive and gamified features, and providing research and safety-oriented functionalities, the simulating chatbot can create a comprehensive learning experience that addresses learners' diverse motivations for interacting with simulators.

4.1.16 Efficiency of Simulators

The respondents were then asked to rate their take on how good the simulator they used was in learning. 14 (16.1%) learners said that simulators were highly efficient in their learning process, 56 (64.4%) learners said it was efficient, 14 (16.1%) said they were not sure, and lastly, 3 (3.4%) said that it was not efficient at all.

The data regarding learners' perceptions of simulators and their effectiveness in learning provides valuable insights for developing a simulating chatbot for training users on blockchain technology. Understanding learners' opinions and experiences with simulators can help design a simulating chatbot that effectively addresses their needs and preferences.

A small percentage of learners, 16.1%, expressed that simulators were highly efficient in their learning process. It indicates that these learners found simulators to be extremely effective tools for acquiring knowledge and skills related to blockchain technology. The simulating chatbot can leverage this positive perception by incorporating high-quality simulations, interactive exercises, and real-world scenarios that provide a realistic and immersive learning experience. By focusing on the strengths of simulators, the simulating chatbot can enhance its effectiveness in supporting learners' understanding and mastery of blockchain concepts.

Most learners, 64.4%, stated that simulators were efficient in their learning process. This finding suggests that most learners perceived simulators as valuable learning tools contributing to their understanding of blockchain technology. To further enhance the efficiency of the simulating chatbot, it can incorporate interactive simulations, guided exercises, and feedback mechanisms that promote active learning and engagement. By

providing clear learning objectives, structured learning paths, and comprehensive content, the simulating chatbot can ensure that learners make the most of their training experience.

A small percentage of learners, 16.1%, expressed uncertainty regarding the efficiency of simulators in their learning process. It indicates a need for the simulating chatbot to address learners' doubts or reservations. The simulating chatbot can clearly explain the benefits and advantages of simulators for learning blockchain technology. It can also offer support and guidance throughout the learning process to help learners overcome uncertainties and maximize the value they derive from the simulating chatbot.

A small percentage of learners, 3.4%, stated that simulators could have been more efficient in their learning process. While this number is relatively low, it is essential to address the concerns of these learners. The simulating chatbot can gather feedback and identify areas where learners feel the simulator falls short. This feedback can be used to improve the simulating chatbot by refining the simulation experiences, enhancing instructional materials, and ensuring that the chatbot addresses these learners' specific learning needs and challenges.

In summary, the data on learners' perceptions of simulators' efficiency provides insights for developing a simulating chatbot that effectively supports users in learning about blockchain technology. By leveraging the positive perception of simulators, addressing uncertainties, and addressing any perceived inefficiencies, the simulating chatbot can deliver an engaging and efficient learning experience. The simulating chatbot can help learners achieve their learning goals and gain a solid understanding of blockchain

technology through interactive simulations, personalized guidance, and continuous improvement based on learner feedback.

4.1.17 Review of the Simulator

In response to whether the respondents would want to be in the review of the application after it has been developed, 114 (100%) said yes.

The data indicating that all respondents (100%) expressed their interest in being involved in reviewing the simulating chatbot application after it has been developed is highly valuable for the development process. This strong interest from the respondents highlights their enthusiasm and willingness to contribute to improving and refining the application actively.

The unanimous agreement of the respondents to participate in the review signifies their desire to have a sense of ownership and engagement with the simulating chatbot. It provides an excellent opportunity to create a user-centric development approach, where the feedback and suggestions from the learners are considered and incorporated into the design and functionality of the chatbot. Involving the users in the review process can help ensure that the simulating chatbot aligns with their expectations, preferences, and learning objectives.

Having all respondents express their willingness to participate in the review allows continuous improvement of the simulating chatbot. The feedback obtained during the review phase can be invaluable in identifying areas of improvement, uncovering potential issues or challenges, and validating the effectiveness of the application in meeting the learners' needs. This iterative development approach ensures that the simulating chatbot

evolves based on real-user input and remains relevant and effective in supporting users' learning experiences.

With the respondents' involvement in the review process, the development team can gather valuable insights into the users' perspectives, expectations, and challenges while using the simulating chatbot. This information can be used to refine the user interface, improve the user experience, and tailor the content and interactions to better align with users' preferences. Incorporating user-centered design principles ensures that the simulating chatbot is intuitive, engaging, and effective in delivering the desired learning outcomes.

The willingness of the respondents to actively participate in the review indicates their commitment to continuous learning and improvement. By involving them in evaluating the simulating chatbot, they become invested stakeholders who can contribute to the ongoing enhancement of the application. This collaborative approach fosters a dynamic learning environment. It allows for incorporating emerging trends, updates, and advancements in blockchain technology to keep the simulating chatbot up-to-date and relevant.

In summary, the unanimous interest of the respondents in participating in the review of the simulating chatbot application provides a strong foundation for developing a user-centric and effective learning tool. By actively involving the learners in the review process, the development team can gather valuable feedback, iterate on the design and functionality, and create an application that aligns with users' needs, preferences, and learning goals. This collaborative approach ensures that the simulating chatbot remains relevant, engaging, and continually improves to meet the evolving demands of the learners in their journey to understand and leverage blockchain technology.

4.2 Summary

This chapter was able to analyze the data obtained from the online questionnaires and came up with findings concerning; the respondent's professional qualifications, whether the respondents have smartphones or not, whether the respondents use the phones for learning, the learning resources that they prefer, the reasons why they choose the resources to use, whether one has an interest in learning Blockchain, whether one understands Blockchain or not, how one rate their understanding, whether Blockchain is hard to learn, whether special training is needed in the teaching of Blockchain, whether one interacted with a Chatbot, whether one used a simulator before or not, how one rates simulators and whether they would want to be part of the simulator review after it has already been created. With all the above responses in mind, the researcher concluded that using a Chatbot simulator in the teaching of Blockchain would be very relevant, meaning that the building of the simulator would be timely. The summary of the results collected has been presented following the study's objectives. The chapter also gave an overview of how the prototype worked and was rated.

CHAPTER FIVE

SYSTEM DEVELOPMENT

5.0 Introduction

This chapter provides an in-depth exploration of critical components related to the system design, prototyping, implementation, testing, deployment, and maintenance, as well as the application and interface of the system. These elements collectively formed the backbone of a robust and functional system, ensuring its successful development, usability, and longevity in practical settings. By addressing these critical elements, the researcher aimed to develop a system prototype that meets user requirements and exhibits high performance, reliability, and user satisfaction.

5.1 Software Development Life Cycle

The researcher used the evolutionary prototyping development mode to create the simulator because of its many advantages. The main advantage is that it reduces cost and allows one to improve the system's quality. The study majors on evolutionary prototyping development methodology used in creating the prototype to learn the Blockchain concept. In this method, the developer can create a model of the actual product.

This methodology includes several phases: requirement gathering, quick design, building prototype, customer evaluation, refining prototype, and engineering product.

5.1.2 Requirement Planning

It is where you develop what you need to create the software successfully. It includes the time frame, the hardware and software components, and the cost of all the items and labor. When creating a system, one needs to know the requirements that are to be used to create the project. The developer understood the need to design. The advantages of the proposed system were analyzed. It is also where the managers can decide whether to support the project, given the analysis of what is needed and the benefits of the end product. The following are the resources that were needed to create the prototype:

Hardware components to build the prototype

- Smart phone
- Laptop (Minimum of 200 MB of RAM, 80GB hard disk space, Intel Core 13 processor)
- USB cables
- Hard drives

Software components to build the prototype

- Android Studio.
- Firebase console
- Java development kit
- Firefox
- Samsung USB Driver for mobile phones
- Json.
- Brainshop semantic engine

- Lottie animations

Other items needed

- Data Bundles.
- Printed and bind documents
- Communication credit
- Biros.
- Fare.
- Notebooks.
- Research expenses.

The software created had both functional and non-functional requirements.

The functional requirements include:

The functional Requirements for the Simulating Chatbot Prototype include the following:

- User Registration: Users should be able to create accounts and register for the training platform.
- User Authentication: The chatbot should authenticate users to ensure secure access to the training content.
- Lesson Modules: The chatbot should offer structured lessons covering various aspects of blockchain technology, including its fundamentals, applications, and implementation.

- Interactive Learning: The chatbot should engage users in interactive learning experiences, such as quizzes, exercises, and simulations, to reinforce their understanding of blockchain concepts.
- Real-time Feedback: The chatbot should provide immediate feedback on users' responses, offering explanations and corrections where necessary.
- Personalized Learning Paths: The chatbot should adapt to users' learning preferences and progress, providing personalized learning paths based on their knowledge gaps and interests.
- Knowledge Repository: The chatbot should maintain a comprehensive knowledge repository containing relevant resources, articles, case studies, and reference materials on blockchain technology.
- Natural Language Processing: The chatbot should utilize natural language processing capabilities to understand users' queries and respond conversationally.
- Progress Tracking: The chatbot should track users' progress throughout their learning journey, allowing them to review completed modules and monitor their overall advancement.
- User Support: The chatbot should offer user support through a helpdesk or a dedicated support team, addressing any technical issues or clarifying doubts related to the training content.
- Accessibility: The chatbot should be accessible on multiple devices and platforms, enabling users to access the training materials from their preferred devices, including desktop computers, smartphones, or tablets.

- Integration with External Resources: The chatbot should integrate with external resources, such as external databases, APIs, or blockchain networks, to provide real-time and up-to-date information to users.
- Reporting and Analytics: The chatbot should generate reports and analytics on users' performance, progress, and areas of improvement, allowing both users and administrators to track learning outcomes.
- Regular Updates: The chatbot should receive regular updates to incorporate new developments in blockchain technology and enhance the training content based on user feedback.

The non-functional requirements include:

- Accessibility. The application should always be available at any time for the user and on all phone versions.
- Data integrity. The application should be able to secure the users credentials and messages to avoid breeching of privacy.
- Compatibility. The application should be able to conform to the screen of the user by adjusting how it looks on different gadgets.
- Reliability. The application should be free of bugs and run swiftly without crushing.
- Usability. The application should be easy to use for everyone starting from the novice user to the Gurus.
- Recoverability. In case of any failures on the application, it should be able to resolve the issue on its own in a short time span.

- Scalability. In case more data or functions are added to the app, it should not affect the performance of the application.
- Secure. Both the system and the user should always be safe from attacks.

5.1.3 System Design and Prototyping

It is where the requirements are used to design and construct the system. It enabled the researcher to know how the components are interconnected. It enabled the researcher to avoid making errors since all the requirements were analyzed according to how they worked and their roles in the project. It gave the designer an overall view of the system's architecture. Java programming was used in the creation of the software. The main platform on which the software runs is Android. The major security source of the software is passwords.

In the study, the incremental and iterative software development process involved active participation from the end users. The first step in the software development process was to gather requirements from the end users. It involved understanding their needs, preferences, and learning objectives related to blockchain technology. The researcher gave out online questionnaires to collect these requirements and ensure the chatbot prototype would address the end user's needs.

Throughout the incremental and iterative development process, the end users actively provided feedback on the chatbot prototype. The researcher sought input from the end users to understand their experience, identify any usability issues or challenges, and gather suggestions for improvements.

The researcher made iterative changes to the chatbot prototype based on the feedback received. These changes could include improvements in user interface design, conversational flow, content presentation, or additional features based on the users' requirements. The end users played a crucial role in shaping the design and functionality of the chatbot through their feedback and suggestions.

The researcher conducted user testing sessions with the end users to assess the effectiveness and usability of the chatbot prototype. The end users were actively involved in these testing sessions, interacting with the chatbot, performing tasks, and providing feedback on their experience. This iterative testing and evaluation process allowed the researcher to identify any issues or areas for improvement and refine the chatbot accordingly.

The insights and feedback from the end users were used to validate and refine the chatbot prototype. The research team analyzed the collected data, identified patterns and trends, and made necessary adjustments to enhance the chatbot's functionality, content, and user experience. This iterative validation and refinement process continued until the chatbot met the desired objectives and effectively addressed the users' needs.

By actively involving the end users throughout the incremental and iterative software development process, the researcher ensured that the simulating chatbot prototype for training users on blockchain technology was user-centered, intuitive, and aligned with the users' requirements. This participatory approach helped create a chatbot that catered to the end user's needs, resulting in an effective and engaging learning tool.

There are several activities on the application which include; the login activity, registering activity, splash screen activity, setup activity. Figure 4 is a flowchart of the proposed software.

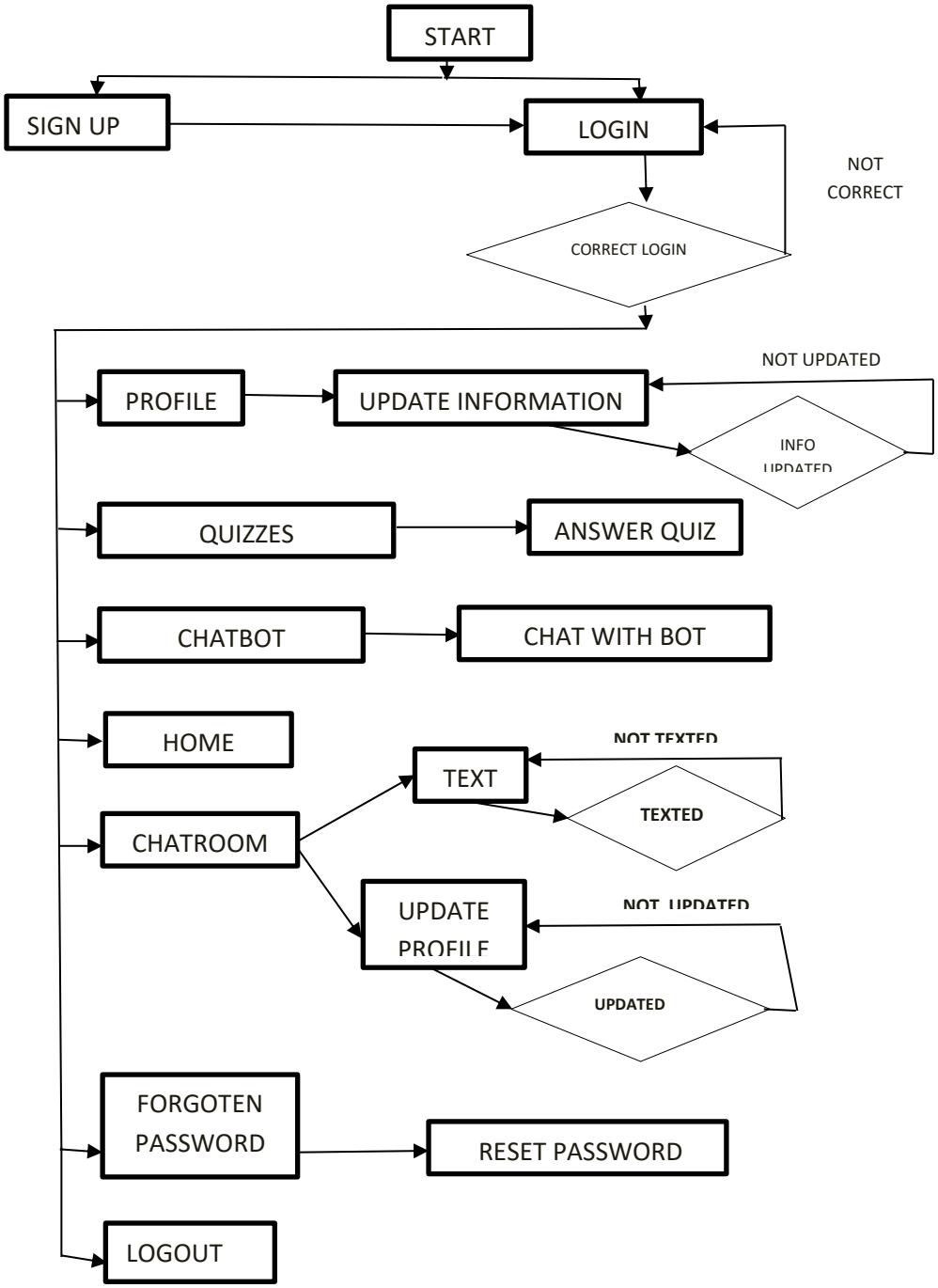

Figure 4: Flowchart of the proposed system

People must log in Whenever they want to join the learning domain. After logging in, they will be redirected to the home page.

On the home page, you can choose the page you are interested in, and the person is taken straight into the learning domain.

The administrator can update information. The administrator needs to provide information such as their name, identification number, username, and password to access the databases. Two slots of learners can use the application. These are the administrator and the users. The use case diagrams in figure 5 and figure 6 explain in totality what the two categories have. The administrator's use case diagram shows what the administrator can do in the system. He/she can view information, delete information, update information, register users, view reports, view users, and delete users.

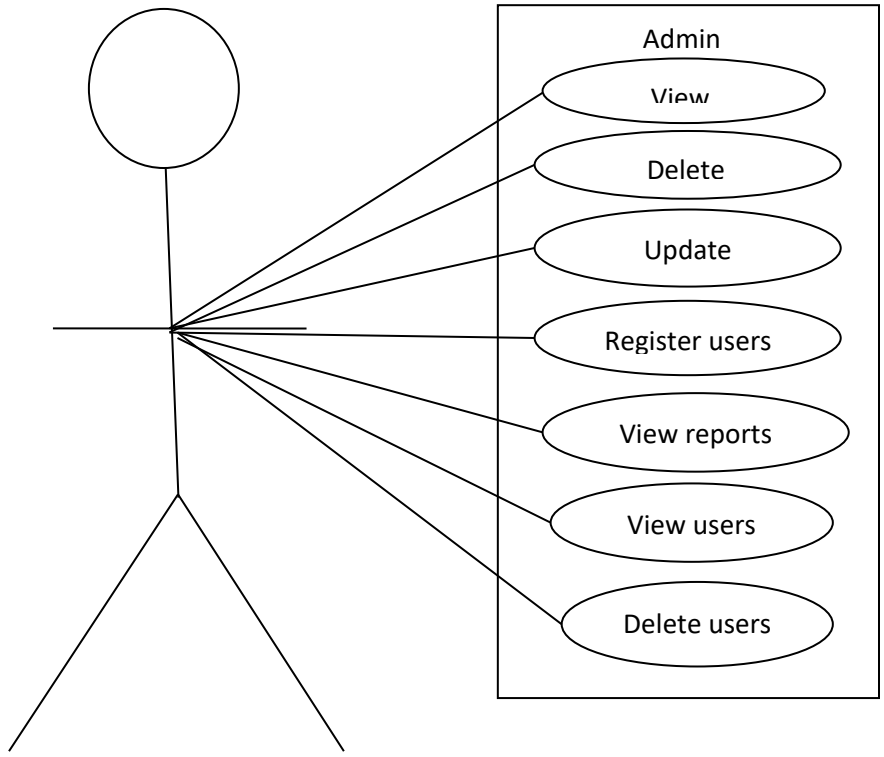

Figure 5: Administrator's use case diagram

The user on the other hand can sign up, login, update profile information, chat with the bot, chat with other learners, and answer quizzes, reset passwords and also logout of the system.

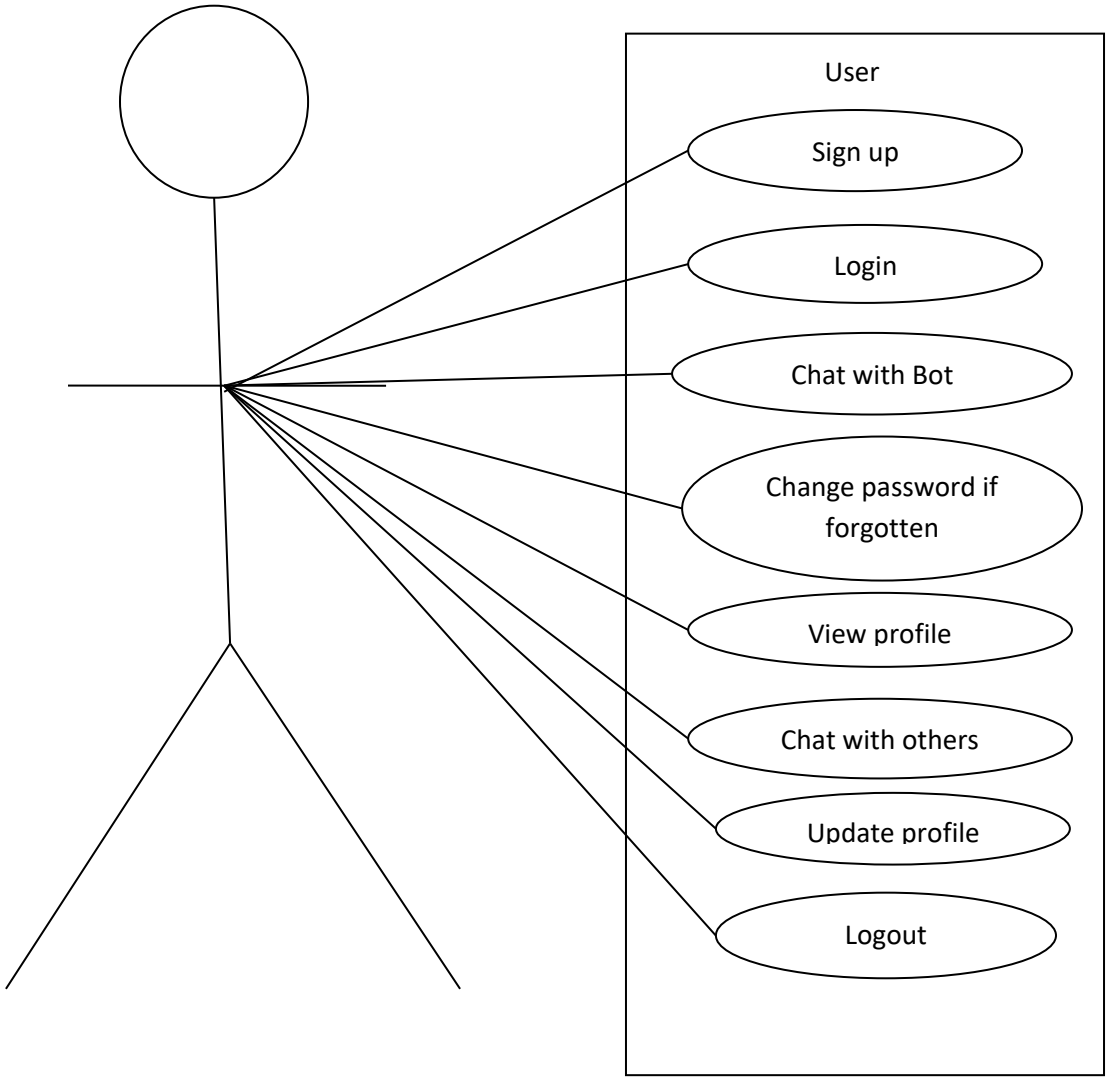

Figure 6: User's use case diagram

5.2 Evolutionary Prototyping

The evolutionary prototyping development methodology allows the developer to create a model of the actual product (Margaret, 2019). This model has several advantages which are linked to this study. The prototype that has been developed can be used in the future since it has room for improvement if any other person wants to continue to improve on this study based on the continuous change in technologies.

This methodology includes several phases: requirement gathering, quick design, building prototype, customer evaluation, refining prototype, and engineering product**.** Requirement gathering is where you explore the research and documentation on what you develop and know what requirements are needed to build the system. Quick design is where a simple design is designed. The design in this stage is a partial design of the system to be created. Building a prototype is where the prototype at hand is created based on what was designed in the quick design stage. Customer evaluation is where the user is given the system to evaluate whether it works as it should. In this case, the developer can know what to change and what to improve. The refining prototype is where the corrections spotted in the previous stage are corrected. Lastly, an engineered product is where the final system is created based on the last prototype. The prototyping methodology was most appropriate due to many reasons. Cost is reduced, and therefore the option of improving the quality of the product has been granted. There has been steady progress in the project since it allows the researcher to follow the development steps systematically. It is useful for risk assessment and to validate the end user. It ensures that the end user does not suffer any issues when using the application. It helps in the understanding of the software's

requirements. Finally, it ensures easy spotting of missing functionalities and errors. An example of a prototype life cycle is as Figure 12.

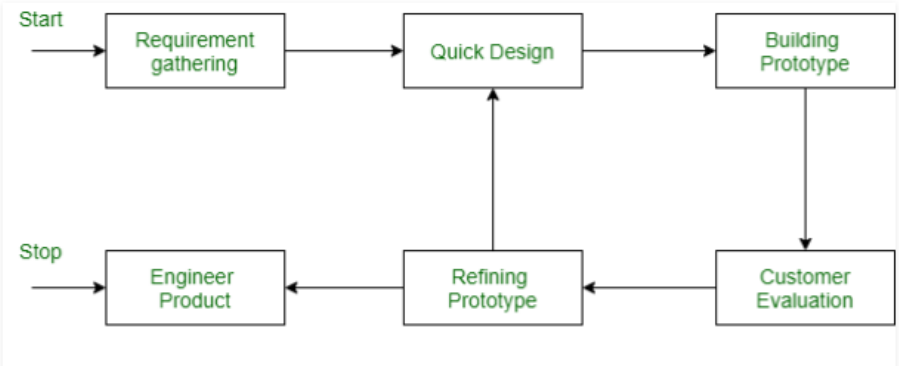

Figure 7: Prototype life-cycle

Note. Figure 12 is an example of the prototyping model (a screenshot of the prototyping model) Advantages and Disadvantages of Prototype model by Vittorio Banfi, 2020. (https://www.geeksforgeeks.org/advantages-and-disadvantages-of-prototype-model/).

5.3 Android Development

According to Sally (2020), Application development is where a developer creates a program or a set of programs to perform differently. All application building follows the same steps: Planning, Analysis, Design, Construction, Testing, Implementation, and support.

Several applications can be used in the building of Android applications. These applications include Android Studio, AIDE, Gradle, Stetho, IntelliJ IDEA, Android asset studio, LeakCanary, GameMaker: Studio, Source Tree, and many more. The Android

Studio is explained in this study because there is a need to understand what was used in the application development. Android Studio is the software that was used.

5.4 Application and Interface

The application prototype developed works on an android platform. It was created by the use of Java language, XML and Firestore database. The application has several windows which include:

5.4.1The Splash screen

Figure 8: The splash screen

Figure 8 is the page that comes up as soon as the application comes on. It contains the logo of the application and a Lottie animation view. It stays on the screen for 3000 milliseconds before the application redirects you to the login page.

5.4.2 The Home Page

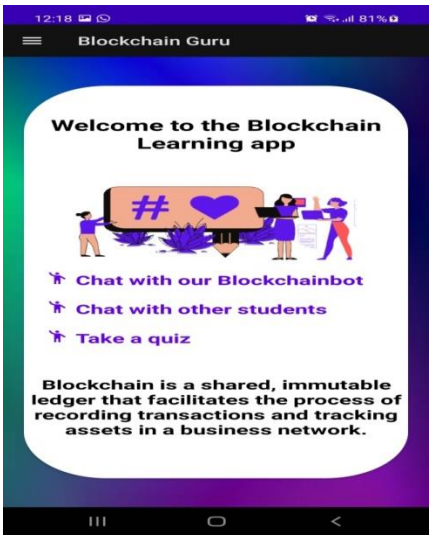

Figure 9: The Home Page

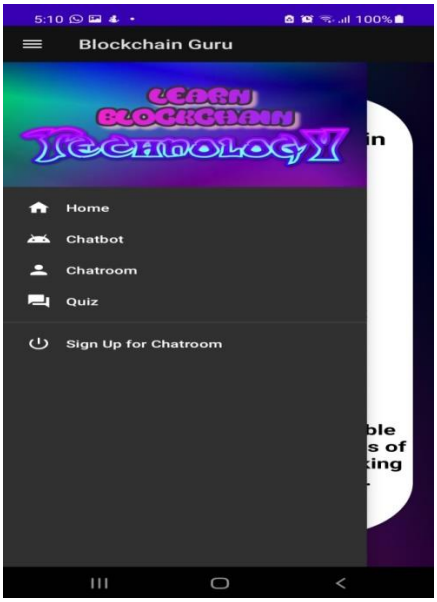

Figure 10: Home Drawer

Figure 9 and 10 is a representation of the home page. The home page consists of all the links to other activities such as the chat room, quiz page, updating profile, and the Chatbot. It gives the learner an overview of what to expect while using the application. A brief definition of Blockchain is also on this page. There is a drawer header that contains several menu items. The items include: The Home, Chatbot, Chat room, Quiz, and Sign Up to the chat room. All the items are clickable and lead to an activity in the application.

5.4.3 The Chatbot

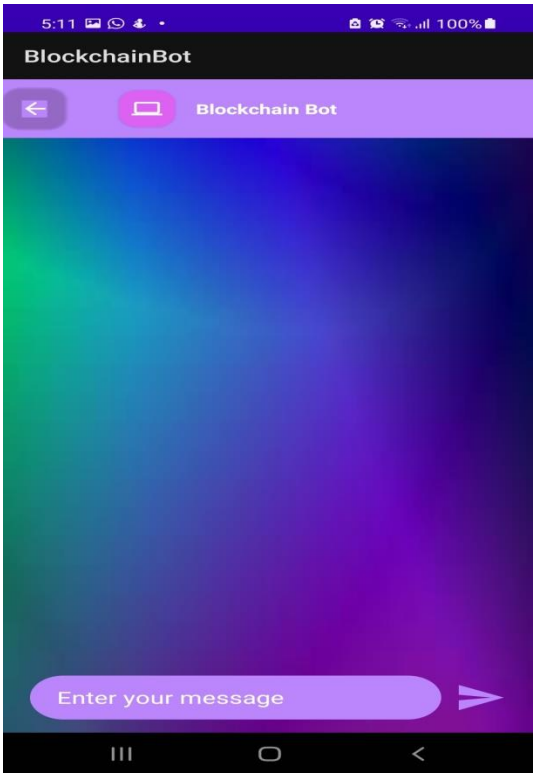

Figure 11: Chatbot

Figure 11 is the Chatbot page where the student can be able to chat with the bot and gain information about Blockchain through chatting.

5.4.4 The Chat rooms

The chat room is a place where all the students can communicate with each other. It contains several compartments. Before accessing the chat room, one needs to sign up and have an account. After that, you are directed to the chat room, where all the application users are listed. You can chat with any of the learners you are interested in and share knowledge on Blockchain too. Figure 12 and 13 are a representation of the firebase which offers its real-time database and authentication features. Firebase offers: a real-time database**,** authentication and user management**,** real-time updates**,** scalability**,** offline Support, security rules, cloud Functions, storage**,** analytics and monitoring and easy integration**.**

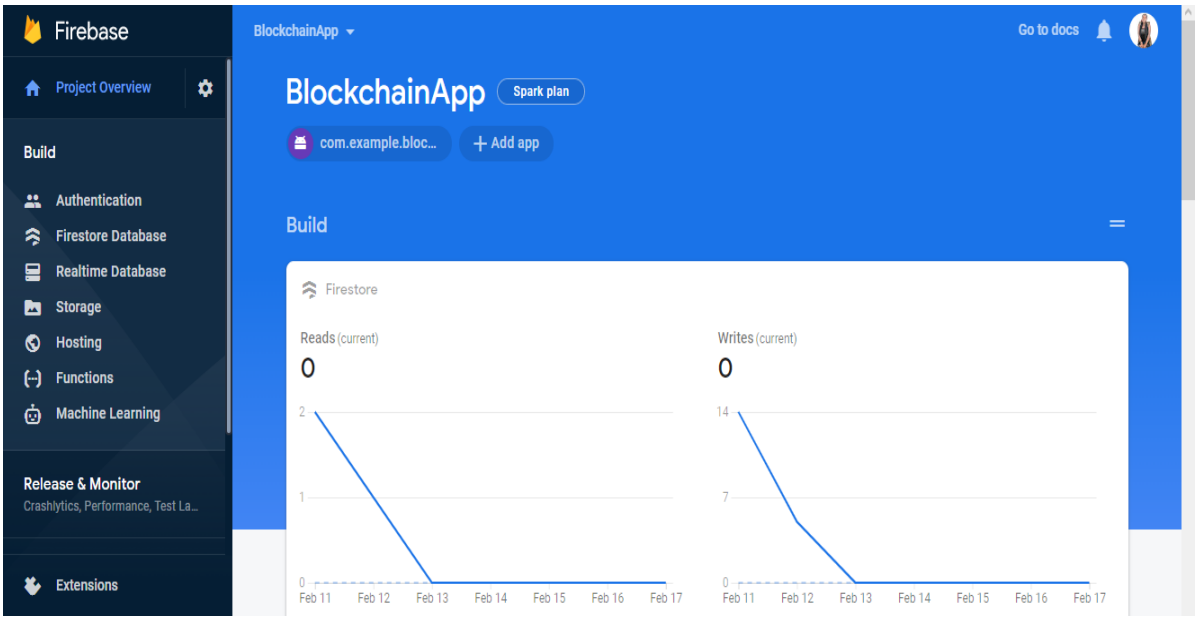

Figure 12: Firebase Picture

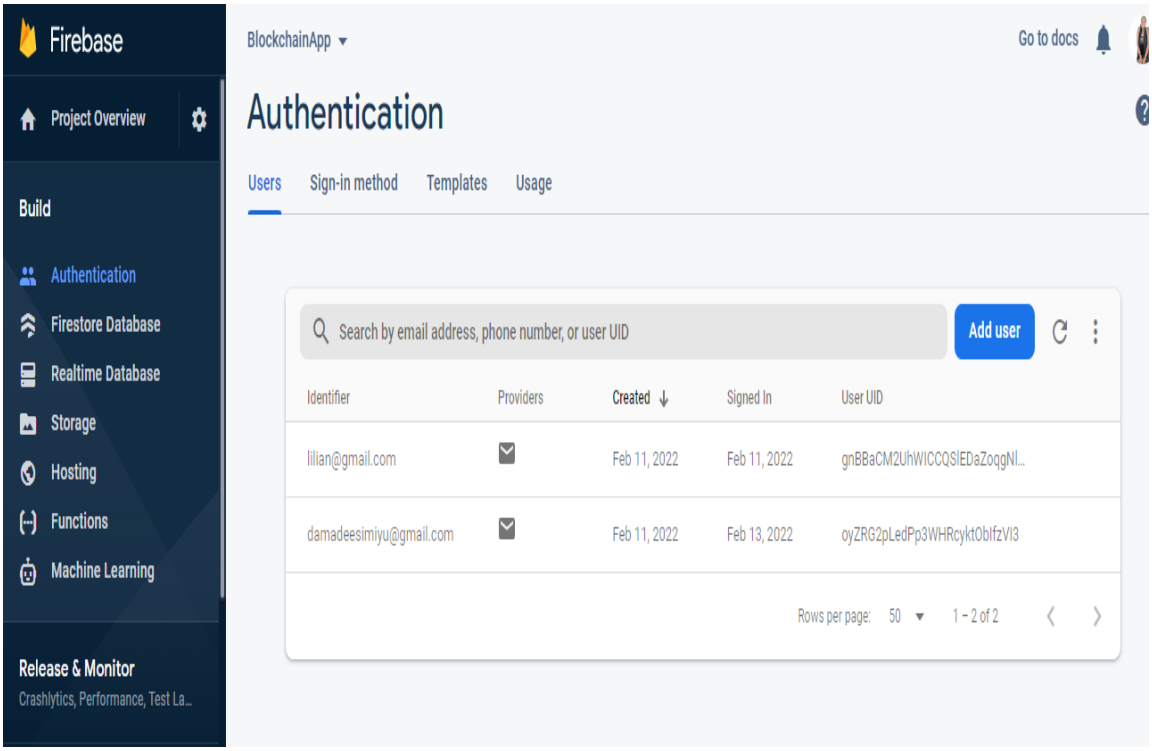

Figure 13: Firebase Authentication

Figure 14 is the login page where the user logs into the application if they have already registered for an account. You need to key in your email and password to log in. You are redirected to the signup page if you do not have an account.

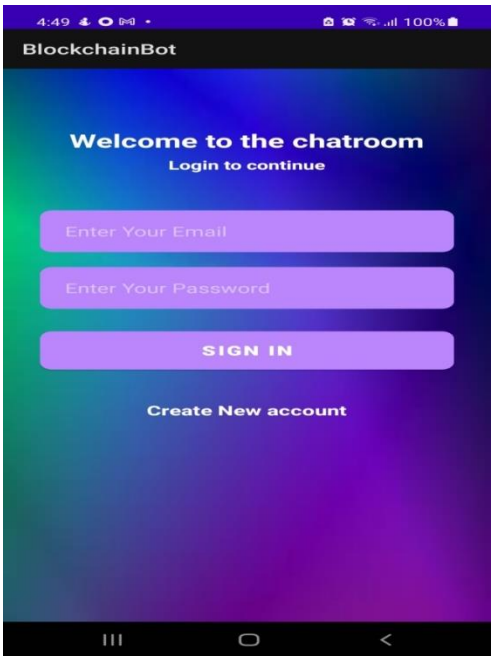

Figure 14: Login Page

Figure 15 is the signup page where you sign up for a new account if you are a visitor to the application and do not have an account. One needs to put in their profile picture, email address, and password, confirm the password they have entered and register the account. It automatically redirects you to the chat. If someone has an account, they are redirected to the login page. When you sign up, all your information is saved on the Firebase platform, the database storage platform linked to the project.

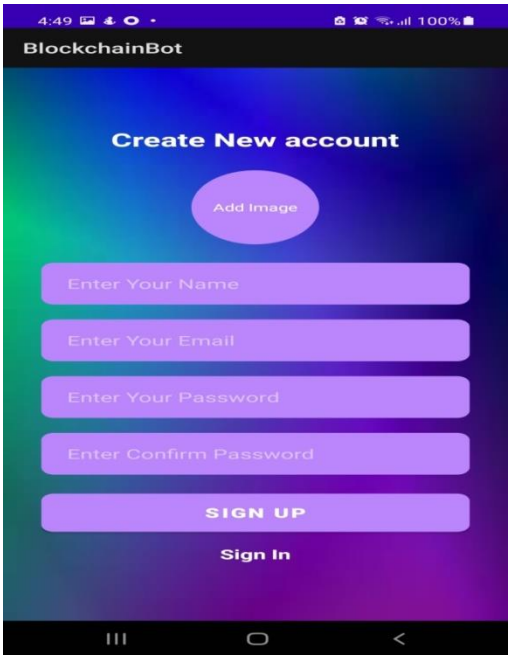

Figure 15: Sign Up Page

Figure 16 is the chat room home page which contains the profile picture, account owner name, a button that leads you to a list of all the learners who have accounts in the application, the logout button, the learners who have texted you, and those you have texted.

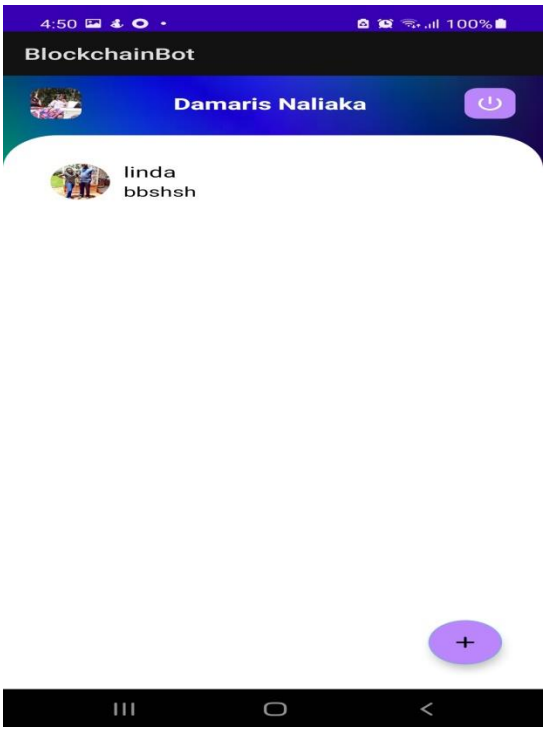

Figure 16: Chat room Home Page

Figure 17 is the select user page which lets you choose whomever you want to chat with on the application. It also contains a back button that sends you back to the chat room home page, the members' emails, and the members' names.

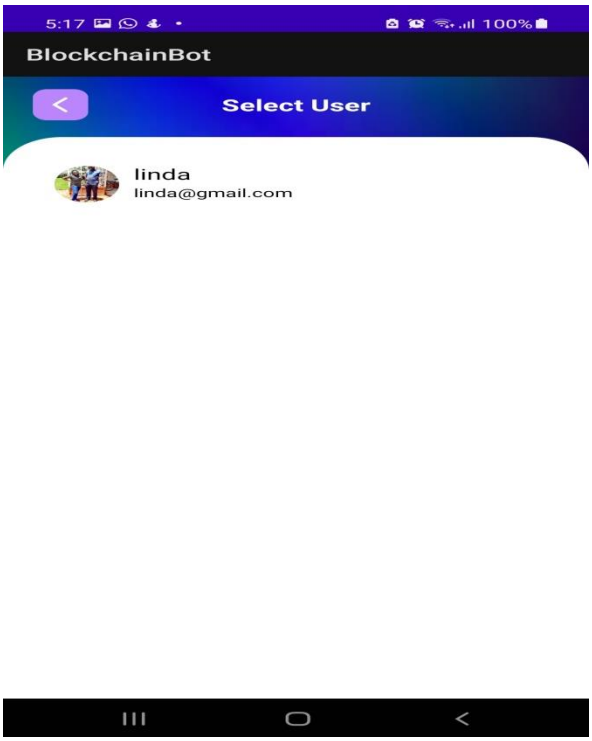

Figure 17: Select User Page

Figure 18 is the individual chat page where the chats are. It contains the back button, the name of the person you are chatting with, the chats, the time, the date, an edit text message space, and a send button.

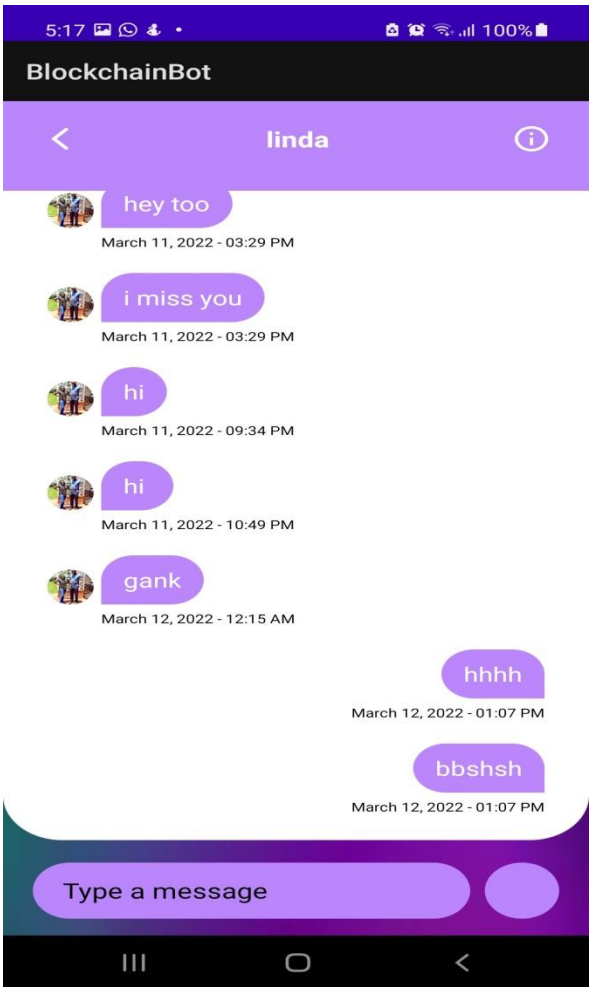

Figure 18: Inbox Page

5.4.5 The Quiz pages

Figure 19 and 20 represent the quiz page which enables one to answer different questions to gauge their learning. The page has a progress bar that shows how far you have reached on the questions. There are also text views showing the score and the number of the question you are tackling.

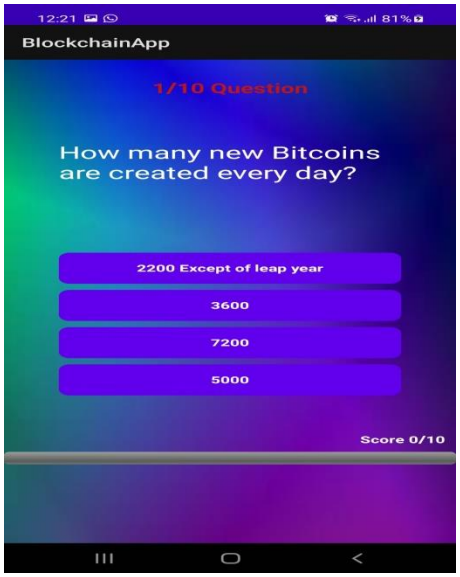

Figure 19: Quiz Introduction

Figure 20: Quiz working

Figure 21 is a representation of the end of the quiz, which is a prompt pop-up box will notify you that it is the end of the quiz and give you your final score. The pop-up box also contains buttons, one leading you back to the questions activity and the other asking you to close the app when you are done.

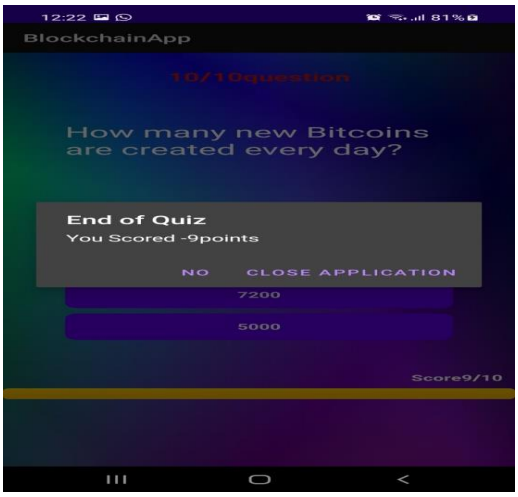

Figure 21: End of Quiz

5.5 System Implementation and Testing

It is where the units from the system design are integrated into a system and later tested for faults and failures. It is where the system which has been created passes through scrutiny to see whether it fits the right specifications. In case of any errors, they were detected in this stage. It enabled the researcher to know whether the system is prone to fail. It is important so that the user does not acquire something of low quality or fails to offer the required service. It is the stage where all the errors are corrected, and, in other cases, new ideas are added to improve the quality of the software.

The application size was looked into and adjusted to fit the needs of users. Figure 22 is a representation of the application size.

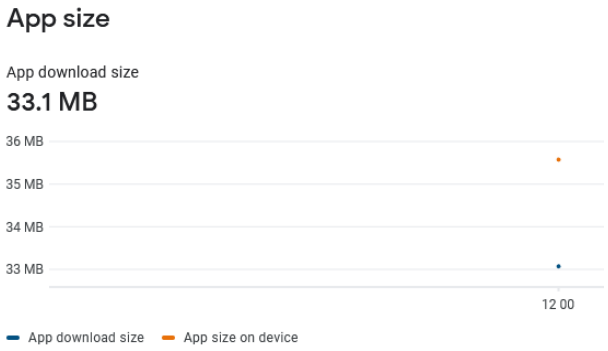

Figure 22: Simulator Application Size

The application size was monitored and compared to that of peers so that the developer could understand what is best for the latest application releases. Several things were done to make the application size fit for all users. These things include: extracting large files, enabling the screen density configuration APKs, Web picture format (Web P) images used, code shrinking and obfuscation done, and lastly, ABI configuration APKs enabled. The size of the application matters because it dictates whether the user keeps the application or uninstalls it. When one optimizes the application, they reduce the number of users who uninstall it. Some learners need more storage space on their phones; therefore, this must be considered. The size of the application versus that of peers' median was +29.4 based on the fact that the application created contains a merging of different functions. The peer's median is 3.44 megabytes which is the exact size of the different modules in the simulator created.

Coding: The coding of the system interactivity was done by the use of JAVA programming language and XML for the display. Firebase was then used for the databases and storage. Two techniques were used in testing. These techniques include code-based testing and user acceptance testing.

Code-based testing: The software codes were tested for several things, for example, the output that was given by the system, how the conditional loops function, the statements in the code, the codes that are broken, the objects in the software, how the inputs flow through the code and the security loopholes that can be found in the code. Test cases were created and executed. A code coverage analysis technique was used in the testing, eliminating gaps in the codes. Unit testing was done on each block of code to evaluate the usability of the software. The JUnit unit testing tool was used to test the code.

User acceptance testing: The software was placed on a phone to enable the users to review whether the application works well. The users gave their takes on the application functionality, and the developer worked on the arising issues.

Validation and verification: The codes were tested at every stage of development by testing the codes for any errors. The review was the major way to test the validity. It was to ensure that the prototype fit the user's needs.

The application was fully stable on all the phones tested and Figure 23 proves it.

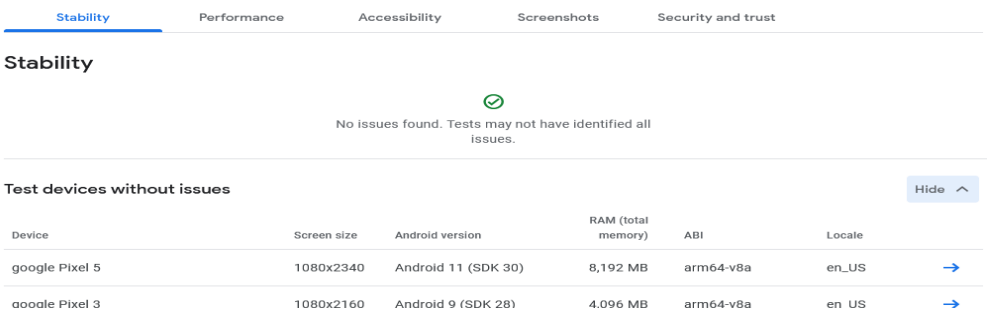

Figure 23: Stability of the application created

There were minimum issues with the performance of the application created. There only two gadgets on testing that had issues in performance. These gadgets include Xiaomi Redmi 6A and Nokia Nokia 1. The problem they face is slow rendering due to the fact that they have small storage spaces and random-access memory. Figure 24 shows the issues found. No phones had issues with the cold start time.

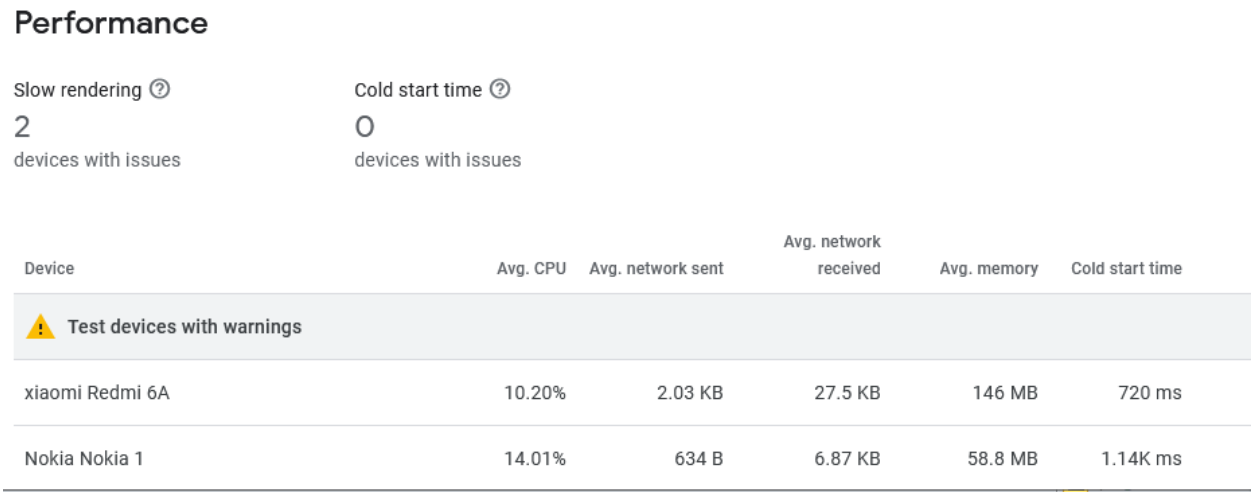

Figure 24: Application performance

On accessibility here were six; six low contrasts, none on implementation and non-on content labeling. The label was clearly visible on all phones. On low contrast, some colors did not blend well with words. All this problem was worked on. There were no issues on the touch target size. All the issues found were minor and solvable. Figure 25 shows the issues.

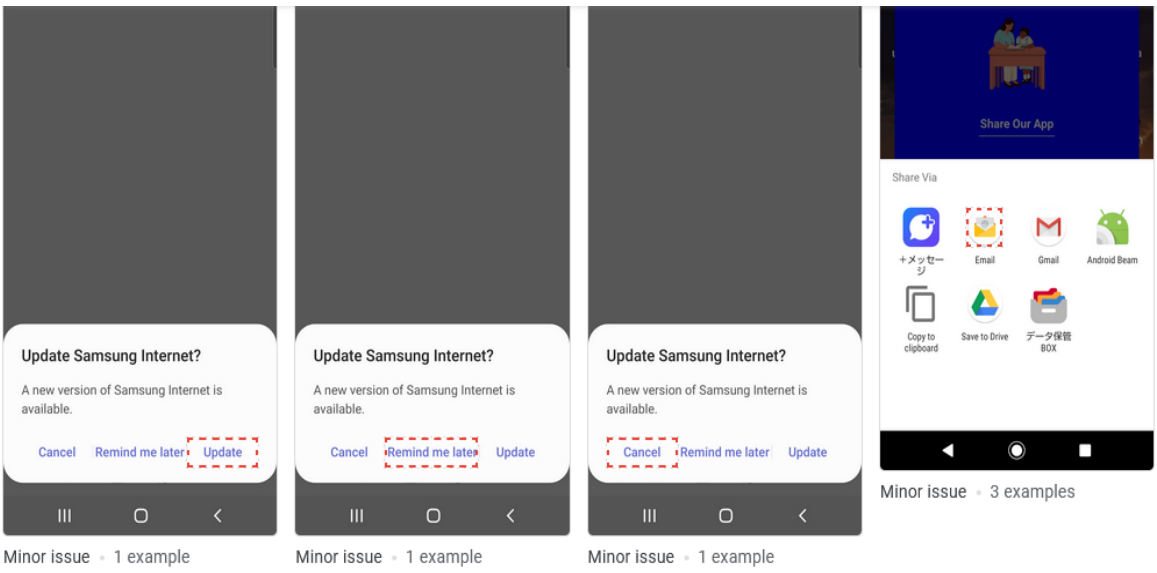

Figure 25: Accessibility issues on created simulator

There were no issues on security and trust. Figure 26 shows the data.

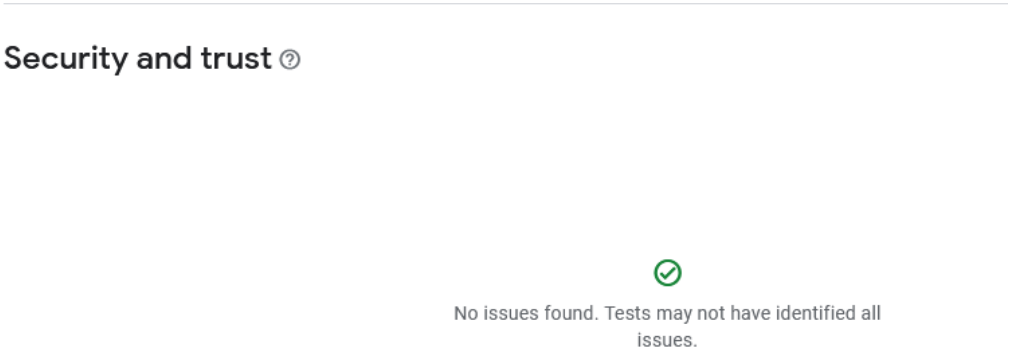

Figure 26: Security and trust

From the testing of the prototype, it was revealed that the prototype had 98% stability on the touch target size. The stability of touch target size refers to measuring the prototype's performance and usability regarding touch interactions on a mobile device. It indicates that the prototype achieved high stability and accuracy in registering and responding to touch inputs on its user interface. In mobile applications, touch target size refers to the area on the screen that users can tap or interact with at all times. Ensuring an adequate touch target size is crucial to enhance user experience, especially when precision in touch inputs is important. This level of stability implies that users could interact with the simulative Chatbot prototype effectively and with minimal errors or inconsistencies. By achieving high stability on touch target size, the prototype demonstrated its usability and responsiveness, which are important factors for engaging users and facilitating effective learning experiences. This finding contributes to evaluating the prototype's performance

and supports its potential for practical application in teaching and learning blockchain technology.

There was a series of usability tests and the employment of specialized tools for touch interaction analysis. They include:

Usability Testing: Engaging participants with varying experience levels in using mobile applications. Each participant was given a specific set of tasks on the prototype, which involved interacting with different touch targets on the screen.

Data Collection: The researcher collected data on participants' interactions with the touch targets during the usability tests. This data was information such as the accuracy of their touch inputs, the time taken to complete the tasks, and any errors or difficulties encountered.

Touch Accuracy Analysis: The collected data was then analyzed to evaluate touch accuracy. The research team used specialized software tools that could precisely measure the position and accuracy of the participants' touch inputs on the prototype's touch targets.

Metrics Calculation: Based on the touch accuracy analysis, the researcher calculated the stability of the touch target size. They determined the percentage of touch inputs that fell within the designated target area for each touch target. Touch input was considered accurate and stable if within the predefined acceptable range.

Evaluation and Iteration: After calculating the stability of the touch target size, the researcher assessed the results. If the stability percentage met their predefined threshold of 98%, it indicated high stability and accuracy in interacting with the touch targets. However, if the stability percentage fell below the desired threshold, further analysis and iterations were conducted to identify potential design improvements or usability issues.

Reporting: The stability findings on touch target size assessment were documented in the research report. The report described the methods, sample size, specific tasks, and metrics employed to calculate the stability percentage.

5.6 Deployment / Operations and Maintenance

When all testing has been done, the final prototype is officially put on real phones running on Android. Several types of phones were used to distribute the application, and it was concluded that it worked well.

5.7 Summary

This chapter has provided a comprehensive overview of system design, prototyping, implementation and testing, deployment and maintenance, and application and interface. The researcher gained insights into the fundamental steps and considerations in developing a robust and functional system by exploring these elements.

The system design and prototyping stage allowed the researcher to create a blueprint and iterate upon it, ensuring that the final design aligns with user requirements and addresses their needs effectively. This phase was the foundation for the subsequent development and significantly contributed to the system's overall success.

The implementation and testing phase played a pivotal role in transforming the design into a functional reality. Utilizing appropriate technologies and rigorous testing methodologies ensured the system met the specified requirements, functions reliably, and delivered a seamless user experience.

Once the system prototype had been developed and tested, the deployment and maintenance stage came into play. Deploying the system made it accessible to end-users

and integrated it into their existing infrastructure. Additionally, ongoing maintenance activities are essential to ensure the system remains operational, secure, and optimized.

The application and interface of the system are crucial aspects that directly impact the user experience. A well-designed and intuitive interface enhances usability and user satisfaction. At the same time, the practical application of the system in specific domains or industries showcases its potential benefits and relevance in real-world scenarios.

The researcher strived to develop a system that met user requirements and demonstrated high performance, reliability, and user satisfaction by addressing these aspects. The careful consideration of system design, prototyping, implementation and testing, deployment and maintenance, as well as application and interface, contributed to the overall success and longevity of the system.

It is essential to monitor the system's performance, gather user feedback, and make necessary updates and enhancements to ensure its effectiveness and relevance. By adopting a proactive approach to system maintenance and incorporating user feedback, maximizing the system's value and adaptability in a rapidly evolving technological landscape is achieved.

Overall, the comprehensive understanding and implementation of these elements are crucial for developing successful systems that fulfill user requirements and provide a seamless user experience and contribute to advancing the respective domain or industry.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.0 Introduction

The chapter provides a detailed discussion of the information collected, and recommendations and suggestions for further research are also stated. The study was carried out to analyze, design, and eventually develop a manageable and user-friendly system to help learn the Blockchain concept. The chapter highlights whether the objectives were achieved or not.

6.1 Summary of Findings

This study aimed to evaluate the effectiveness of the current systems in teaching Blockchain to develop a Chatbot prototype to teach and learn Blockchain technology. It was inspired by the fact that Android applications have become so popular and widely used. The literature review establishes that almost all sectors, including education, are beginning to embrace Android as part of their day-to-day working systems fully.

Based on the first objective, the current systems used to teach and learn Blockchain technology were determined. The current systems include G Suites, Gamification software, Social media platforms, Films, Education-focused social media platforms, Radio lessons, Phone applications, Simulators, Motion graphics, Websites, Video conference Lectures, Online Past papers, Books, Kindles, Magazines, and newspapers. Understanding the current landscape of instructional tools and resources provides valuable insights into the existing approaches to teaching blockchain technology. A mixed method research

approach was used in the study where quantitative data was collected using Google Forms questionnaires while qualitative data was collected from document analysis. The tools provided enough information on the respondents' tools in teaching and learning concepts and how effective they were. This comprehensive approach allowed the researchers to assess the tools and gauge their efficacy. The findings shed light on the perceived effectiveness of the different systems and provide valuable feedback on their strengths and weaknesses.

The second objective was to analyze the simulative Chatbot concerning the teaching and learning of Blockchain technology. The respondents were asked whether they had ever used Chatbots and simulators, and they established that most of them had interacted with at least one of the two technologies. Those who had interacted with Chatbots and Simulators asked how effective the technologies were for them, and most of them established that it was highly effective in teaching and learning. This information suggests the potential benefits of simulating chatbotsChatbot in the development process.

The third objective was to design and develop a simulative Chatbot for teaching and learning Blockchain technology. An application was developed using the evolutionary prototyping development method. The prototype was based on Java programming, Firestore database, and XML. This objective aimed to bridge the identified gap in instructional resources by creating a dedicated chatbot that can enhance the learning experience and promote a better understanding of blockchain technology.

The provided data showcases the rationale behind the study, the current systems in place, the effectiveness of these systems, the role of simulative chatbots, and the development of

a dedicated chatbot prototype. This information provides valuable insights for developing a simulating chatbot for training users on blockchain technology, enabling the creation of an effective and engaging learning tool that aligns with the identified needs and preferences of the learners.

6.2 Conclusion

In conclusion, this research aimed to determine the effectiveness of current systems in learning Blockchain technology and develop a simulative Chatbot prototype for learning Blockchain. The study adopted a mixed-method research approach, utilizing Siemens Theory of Connectivism and B.F Skinner's Theory of Behaviorism as the theoretical framework. One hundred fourteen respondents gave responses through online Google forms and document analysis.

The findings revealed that the simulative Chatbot proved to be an effective tool for learning Blockchain technology. The prototype demonstrated a stability rate of 98% on touch target size, indicating its reliability. The prototype testing also showed that learners could quickly grasp the concepts of Blockchain, highlighting the Chatbot's potential to facilitate understanding.

The implications of this research are significant. It emphasizes the need for specialized training in learning Blockchain technology, as it is a complex subject that requires dedicated resources. The study recommends developing systems such as Android applications to teach and facilitate learning complex technologies like Blockchain effectively.

The contributions of this research extend both theoretically and practically. The findings advance understanding of effective teaching and learning strategies in the context of

Blockchain education. The development of the simulative Chatbot prototype enhances accessibility, engagement, and learning outcomes in Blockchain education, potentially benefiting a wider audience of learners. Its contribution to Theory includes:

Enhanced Understanding of Learning Processes: Developing a simulative chatbot for learning Blockchain can contribute to theories of education and cognitive science by providing insights into how individuals learn complex concepts and technologies. It can help researchers understand the effectiveness of interactive and personalized learning environments in improving knowledge acquisition and retention.

Integration of Artificial Intelligence and Education: Developing a chatbot for learning Blockchain involves integrating artificial intelligence techniques with educational contexts. It contributes to the theoretical understanding of how AI can be effectively utilized in educational settings and expands upon existing theories of AI-enhanced learning environments.

Exploration of Blockchain Learning Strategies: Designing a simulative chatbot allows one to explore and evaluate different learning strategies and approaches for teaching Blockchain. It can contribute to developing instructional theories and models specific to blockchain education, such as adaptive learning, scaffolding, and problem-based learning. In practice, the research findings have immediate applications. Educational institutions and organizations can leverage the Chatbot prototype as a valuable tool for teaching Blockchain technology. The prototype's stability and effectiveness in facilitating learning make it a good resource for educators and learners in the field. Other Contributions include:

Enhanced Learning Experience: The simulative Chatbot can provide learners with a hands-on and interactive learning experience, allowing them to apply theoretical knowledge in

practical scenarios. It can enhance learners' engagement, motivation, and knowledge retention by offering real-time feedback, guidance, and opportunities for active exploration.

Personalized and Adaptive Learning: By leveraging AI techniques, the Chatbot can adapt to individual learners' needs, preferences, and learning styles. It can provide personalized content, targeted interventions, and tailored support, promoting self-paced learning and addressing specific challenges or misconceptions.

Increased Accessibility and Scalability: The development of a simulative chatbot can contribute to making blockchain education more accessible and scalable. It can provide a cost-effective and widely available learning tool that reaches a larger audience, including learners needing access to traditional educational resources or specialized training programs.

Evaluation and Improvement of Blockchain Training: The simulative Chatbot can be an assessment tool to evaluate learners' understanding and proficiency in blockchain concepts. Through the analysis of learner interactions and performance, educators and developers can identify areas of improvement in instructional design, content delivery, and learner support, leading to iterative enhancements in blockchain training programs.

This research sheds light on the importance of specialized systems, such as the simulative Chatbot, in enhancing the learning of complex technologies like Blockchain. It contributes to the advancement of both Theory and practice, opening new avenues for improving the accessibility and effectiveness of Blockchain education. The study has contributed to both.

6.3 Recommendations

Based on the findings and conclusions of the study, the recommendations developed were:

1. Expand the Use of Simulative Chatbots: The study highlights the effectiveness of simulative Chatbots in facilitating the learning of Blockchain technology. Learners should explore and expand the use of Chatbots in other areas of education and training. It can include developing Chatbots for different domains and subjects to provide personalized and interactive learning experiences.
2. Enhance Accessibility through Mobile Applications: The study utilized an Android-based Chatbot prototype, emphasizing the potential of mobile applications in making learning resources more accessible. Mobile applications can deliver educational content and support the learning of Blockchain technology, reaching a wider audience and enabling learning anytime and anywhere.
3. Continuous Testing and Improvement: To ensure the effectiveness and reliability of Chatbot-based learning systems, continuous testing and improvement are crucial. Ongoing evaluation and feedback from learners should be incorporated to identify areas for enhancement and optimize the Chatbot's functionality, user experience, and content delivery.
4. Collaboration between Industry and Academia: Given the rapidly evolving nature of Blockchain technology, to foster collaboration between industry practitioners and academia. This collaboration can help develop up-to-date and relevant educational resources, ensure alignment with industry needs, and provide real-world use cases and scenarios for learners to apply their knowledge.

5. Long-term Assessment of Learning Outcomes: To gauge the long-term effectiveness of the simulative Chatbot and other learning interventions, conduct longitudinal studies assessing the retention and practical application of Blockchain knowledge. The long-term assessment provides insights into the sustainability of learning outcomes and the effectiveness of the Chatbot as a long-term learning tool.

By implementing these recommendations, educators, developers, and stakeholders can further enhance the teaching and learning of Blockchain technology, making it more accessible, engaging, and effective for learners across different backgrounds and skill levels.

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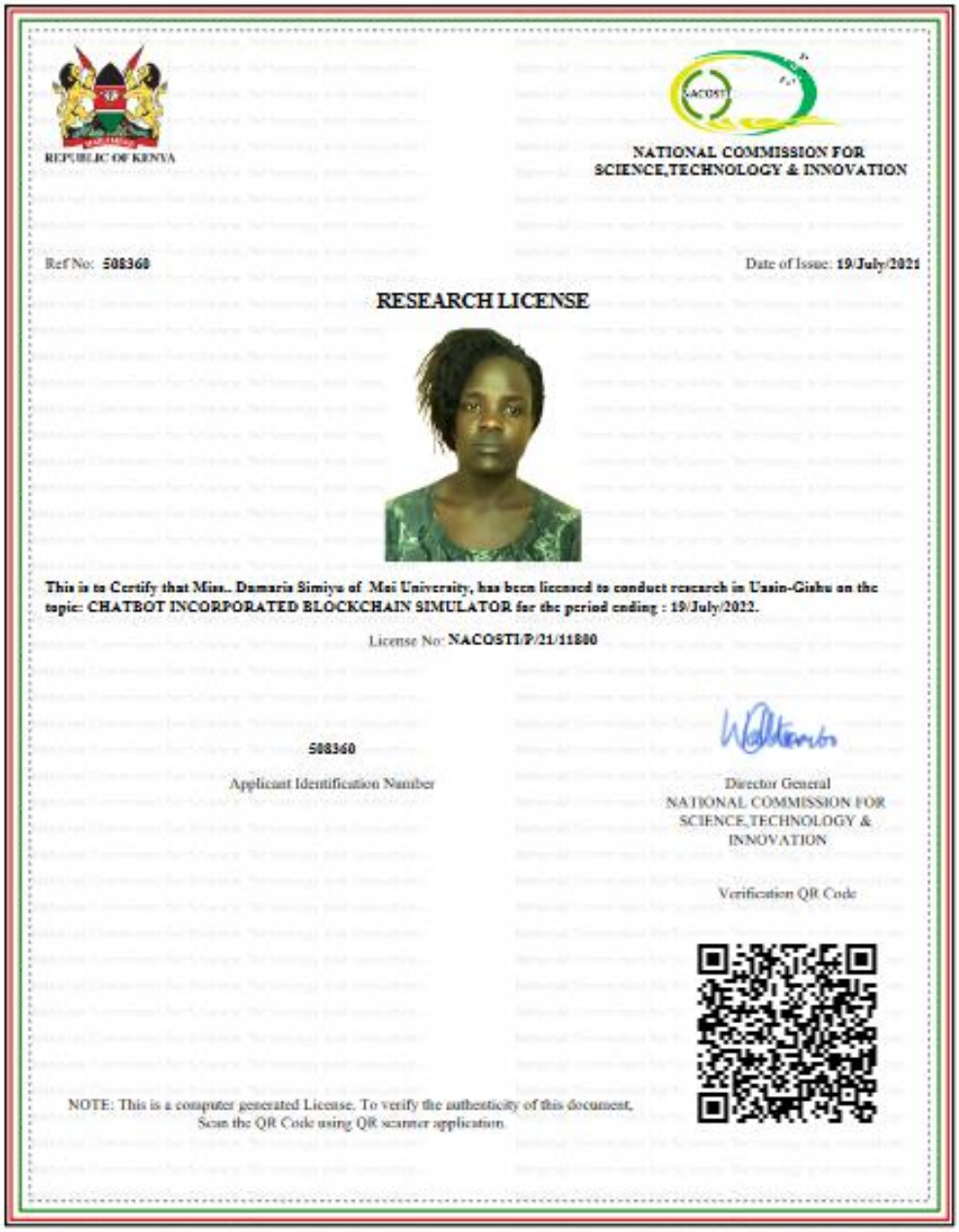
APPENDICES

APPENDIX I: RESEARCH AUTHORIZATION PERMIT



REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: 508360

Date of Issue: 19/July/2021

RESEARCH LICENSE

This is to Certify that Miss.. Damaris Simiyu of Moi University, has been licensed to conduct research in Uasin-Gishu on the topic: CHATBOT INCORPORATED BLOCKCHAIN SIMULATOR for the period ending : 19/July/2022.

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APPENDIX II – INFORMED CONSENT FORM

Consent for Participation in a Simulating Chatbot for Training Users on Blockchain Technology Questionnaire

You are being invited to participate in a questionnaire as part of a research study aimed at evaluating the effectiveness of a simulating chatbot for training users on blockchain technology. Before deciding to participate, it is important for you to understand the purpose of the study, the procedures involved, and any potential risks or benefits associated with your participation. Please read the following information carefully and feel free to ask any questions before providing your consent.

Research Purpose: The purpose of this research study is to gather information and insights about the user experience and effectiveness of the simulating chatbot in training users on blockchain technology. The data collected through this questionnaire will be used for research purposes only, and all responses will be anonymized and treated with strict confidentiality.

Procedures: If you decide to participate in this study, you will be asked to complete an online questionnaire consisting of multiple-choice and open-ended questions related to your experience with the simulating chatbots for blockchain training. Your responses will be recorded and analyzed to assess the effectiveness of the chatbot and improve its training capabilities.

Potential Risks and Benefits: There are no anticipated risks associated with participating in this questionnaire. However, some questions may require you to recall your experiences with the simulating chatbot, which may elicit minor discomfort or frustration. Your participation in this study is voluntary, and you have the right to withdraw at any time without penalty. By completing and submitting the questionnaire, you are providing your informed consent to participate in the study.

Confidentiality: All information provided in this questionnaire will be treated with strict confidentiality. Your responses will be anonymized, and no personally identifiable information will be collected. The data collected will be securely stored and accessible only to the researcher involved in this study. The findings may be presented in aggregated and anonymous form in research publications or presentations.

Voluntary Participation: Participation in this study is entirely voluntary, and you have the right to refuse or withdraw at any time without providing a reason. Your decision to participate or not will not affect your current or future relationship with the researcher or any associated institutions.

Contact Information: If you have any questions or concerns regarding this study, you may contact Damaris Naliaka Simiyu at damadeesimiyu@gmail.com.

I have read and understood the information provided above. I voluntarily agree to participate in the questionnaire for the research study on a simulating chatbot for training users on blockchain technology.

Participant's Name: _____

Participant's Authorization (I accept/ I do not accept): _____

Date: _____

APPENDIX III – ANTI-PLAGIARISM CHECK CERTIFICATE

SR113

THESIS WRITING COURSE

PLAGIARISM AWARENESS CERTIFICATE

This certificate is awarded to

DAMARIS NALIAKA SIMIYU

IS/M/1/03/18

In recognition for passing the University's plagiarism

Awareness test with a similarity index of 01% and

Striving to maintain academic integrity.

Awarded by:

Prof. John Changách, CERM-ESA Project Leader

12th /09/2022

APPENDIX IV - QUESTIONNAIRE

Blockchain Simulation Chatbot Questionnaire

The research aimed at finding out how learners learn new technologies and the efficiency of technological tools they use. The feedback obtained from this questionnaire generated knowledge towards the simulator Chatbot created. This questionnaire was administered on selected learners interested in learning Blockchain, for example, Blockchain Business learners, ICT practitioners, Engineers, Lecturers, and Students.

All the information given in this form was confidential.

I greatly appreciate your input!

***Required**

QUESTION ONE

Professional qualification *

- IT consultant
- Computer scientist
- Lecture
- Student
- Business person
- Engineer
- Other

QUESTION TWO

Gender *

- o Male
- o Female
- o Prefer not to say

EXISTING TECHNOLOGIES

This section comprises of questions to do with the technologies that are already in use by the respondents and what they think about their efficiency in teaching and learning

QUESTION THREE

Which technologies do you find hard to learn? (Choose all that apply) *

- □ Blockchain
- □ Internet of Things
- □ Artificial Intelligence and machine learning
- □ 5G Technology
- □ Internet of Behaviors (IOB)
- □ DevSecOps
- □ Intelligent Process Automation (IPA)
- □ Cybersecurity
- □ Tactile VR
- □ Everything-as-a-service (Xaas)

☐ Big Data Analytics ☐ Human Augmentation ☐ Robotic Process Automation (RPA) ☐ Quantum Computing ☐ Edge Computing ☐ Virtual Reality and Augmented Reality ☐ Serverless Computing ☐ Biometrics ☐ Natural Language Processing ☐ Other
QUESTION FOUR
Do you have a smart phone? * ☐ Yes ☐ No
QUESTION FIVE
If yes, do you use the smart phone for learning? ☐ Never ☐ Sometimes ☐ Always
QUESTION SIX
What online resources of learning do you prefer to use? (Indicate as many as you use) *

- ☐ Simulators
- ☐ Chatbots
- ☐ Quora
- ☐ LinkedIn
- ☐ Google scholar
- ☐ Textbooks
- ☐ Magazines
- ☐ Twitter
- ☐ Facebook
- ☐ Lectures
- ☐ Radio lessons
- ☐ Tape recordings
- ☐ Films and videos
- ☐ Pictures and photographs
- ☐ YouTube
- ☐ Udemy
- ☐ Skill share
- ☐ Chegg
- ☐ Articles
- ☐ Forums
- ☐ Blogs
- ☐ Course hero

QUESTION SEVEN

Why do you use the resources above? (Choose all that apply) *

- ☐ Convenience
- ☐ Recommended
- ☐ No otherwise
- ☐ Best choice for you
- ☐ Other

YOUR TAKE ON BLOCKCHAIN

Blockchain is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a business network.

QUESTION EIGHT

Do you have any interest in learning Blockchain? *

- ☐ Yes
- ☐ No
- ☐ Maybe

QUESTION NINE

Do you understand what Blockchain is? *

- ☐ Yes
- ☐ No
- ☐ Not sure

QUESTION TEN

If yes, how would you rate your understanding?

	1	2	3	4	5	
Very Good	O	O	O	O	O	Very poor

QUESTION ELEVEN

Blockchain is hard to learn *

- o Strongly agree
- o Agree
- o Neutral
- o Disagree
- o Strongly disagree
- o Uncertain (Not sure / I don't know)

QUESTION TWELVE

Do you think special training in new technologies is essential for those interested to learn??

- □ Yes
- □ No
- □ Maybe

CHATBOTS AND SIMULATORS

A Chatbot is a software application used to conduct an on-line chat conversation via texts or speeches. A Simulator is a machine or software designed to provide a realistic imitation of the controls and operation of a vehicle, aircraft, or other complex systems, for training/teaching purposes.

QUESTION THIRTEEN

Have you ever interacted with a Chatbot? (for example: Android Google assistant) *

- □ Yes
- □ No
- □ Maybe

QUESTION FOURTEEN

If yes, what for? (Choose all that apply)

- □ Learning purposes
- □ Entertainment
- □ Running of day to day operations
- □ Companionship

QUESTION FIFTEEN

What was your take on its efficiency?

- o Highly efficient
- o Efficient

- Not sure
- Not efficient

QUESTION SIXTEEN

Have you ever interacted with a simulator? (for example: Blue stacks for windows which enables learners to use android application on laptops) *

- Yes
- No
- Maybe

QUESTION SEVENTEEN

If yes, what for? (Choose all that apply)

- ☐ Education for example: training and testing
- ☐ Entertainment for example: Gaming
- ☐ Research
- ☐ Safety engineering for example: Virtual plane flying

QUESTION EIGHTEEN

What was your take on its efficiency?

- ☐ Highly efficient
- ☐ Efficient
- ☐ Not sure
- ☐ Not efficient

QUESTION NINETEEN
Would you like to take part in the review of the developed Chatbot? * □ Yes □ No

APPENDIX V – APPLICATION TESTING CHECKLIST

The following is a test that was done on the application to see if it works efficiently and can be used by the student well without having any troubles. This test was done through the perfecto platform which is where most developers go when they want to grade how effective their applications are.

	Testing Scenario	**Result Expected**	**Fail/Pass**	**Defect**
1	Install	Does the application install successfully?	PASS	NONE
2	Launching	Does the app take a short time to launch?	PASS	NONE
3	Uninstall	Does the application uninstall successfully?	PASS	NONE
4	Other features	Do other functions such as the camera and screen resolution work well when the application is running?	PASS	NONE
5	Call interruption	Can user accept Phone calls when application is running and continue from the same point after the call?	PASS	NONE

6	Message interruption	Can user accept messages when application is running and continue from the same point after reading the message?	PASS	NONE
7	Compatibility	Is the app compatible with most device specific features, screen resolutions, changes in the UI, screen sizes and OS specific features?	PASS	NONE
8	Network conditions	Does the app work well in varying network conditions?	PASS	NONE
9	Memory	Can application display proper error message when device memory is low?	PASS	NONE
10	UX testing	Is the navigation good? Is the menu of the app working well?	PASS	NONE
11	Exit and entering application	Can user exit and enter application successfully?	PASS	NONE
12	Outlook	Is the app readability good? (Dynamic font sizes, screen reader compatible, text color contrast)	PASS	NONE

13	Securing	Does the app have two factor authentication and proper storage of user information?	PASS	NONE
14	Battery	Does the app allow display of battery low?	PASS	NONE
15	Battery Consumption	Does application affect the battery harshly?	PASS	NONE
16	Charge	Does application run when inserting the charger and not affect the application?	PASS	NONE

APPENDIX VI – SAMPLE CODE

The following code is the android manifest code that covers all the activities that the application has.

```
<?xml version="1.0" encoding="utf-8"?>
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.example.blockchainbot">

    <uses-permission android:name="android.permission.INTERNET"/>

    <application
        android:allowBackup="true"
        android:icon="@mipmap/ic_launcher"
        android:label="@string/app_name"
        android:roundIcon="@mipmap/ic_launcher_round"
        android:supportsRtl="true"
        android:theme="@style/Theme.BlockchainBot">
        <activity
            android:name=".quiz"
            android:exported="false" />
        <activity
            android:name=".chatbot"
            android:exported="false" />
```

```
<activity
   android:name=".about"
   android:exported="false"                                    />
<activity
   android:name=".Splash"
   android:exported="true">
   <intent-filter>
      <action              android:name="android.intent.action.MAIN"          />

      <category       android:name="android.intent.category.LAUNCHER"      />
   </intent-filter>
</activity>
<activity
   android:name=".activities.ChatActivity"
   android:exported="false"
   android:windowSoftInputMode="adjustResize"                  />
<activity
   android:name=".activities.UsersActivity"
   android:exported="false"                                    />
<activity
   android:name=".activities.SignUpActivity"
   android:exported="false"
   android:windowSoftInputMode="adjustResize"                  />
```

```
        <activity
            android:name=".activities.SignInActivity"
            android:exported="true"
            android:windowSoftInputMode="adjustResize" />
        <activity
            android:name=".MainActivity"
            android:exported="true" />

        <service
            android:name=".firebase.MessagingService"
            android:exported="false">
            <intent-filter>
                <action android:name="com.google.firebase.MESSAGING_EVENT" />
            </intent-filter>
        </service>
    </application>

</manifest>
```