LEX LOCALIS-JOURNAL OF LOCAL SELF-GOVERNMENT
ISSN:1581-5374 E-ISSN:1855-363X
VOL. 22, NO. S4(2024)

COGNITIVE COMPLEXITY REDUCTION IN DECENTRALIZED APPLICATIONS BASED ON BLOCKCHAIN TECHNOLOGY: THE PSYCHOLOGICAL ASPECTS OF USER INSTRUCTION, UNDERSTANDING, AND SELF-EFFICACY

Muhammad Farooq[1], Humera Amin[2], Jose Anand A[3]., Muhammad Waseem Iqbal[4]

[1]Department of Computer Science, Superior University Lahore, 54000, Pakistan
[2]Department of Agricultural Extension and Rural Studies, College of Agriculture, University of Sargodha 40100, Pakistan
[3]Department of Electronics And Communication Engineering,, KCG College Of Technology, Chennai, Tamil Nadu, India 600097
[4]Department of Computer Science, Superior University Lahore, 54000, Pakistan

su92-phcsw-f22-004@superior.edu.pk[1]
humera.amin@uos.edu.pk[2]
joseanandme@yahoo.co.in[3]
Waseem.iqbal@superior.edu.pk[4]

Abstract Blockchain-based decentralized applications (dApps) face low user adoption owing to high cognitive complexity and psychological barriers, making it difficult for first-time users to understand and operate. This challenge is important because user comprehension, confidence, and perceived ease of use directly influence behavioral acceptance of decentralized systems. Although previous studies have noted usability gaps in blockchain interfaces, few studies have examined whether structured user instructions can reduce cognitive load. This study used a comparative experimental design with 200 participants with no prior dApp experience. User interaction with a centralized application was first assessed, followed by a task-based evaluation of the three dApps. Subsequently, the participants received guided education and practical training. The results show a clear improvement in user readiness: initially, 95% required assistance when using dApps, but post-training, 74% reported higher confidence and comfort levels increased from 20% to 80%. Descriptive statistics and comparative analyses were performed to assess these changes. Overall, the study demonstrates that targeted user education and structured guidance effectively reduce cognitive complexity and enhance acceptance of blockchain-based applications.

Keywords Blockchain Adoption, Decentralized Applications (dApps), Cognitive Complexity, User Education and Self Efficacy, Usability and Behavioral Acceptance

1 Introduction

Decentralized applications (dApps) are the next shift in the software development process because, unlike centralized servers, it relies on blockchain or peer-to-peer networks for its operations (Zheng et al., 2023). In the realm of architecture, it indicates that dApps have heightened security, transparency, and independence, which are their main advantages over other applications (Jang et al., 2020). Nevertheless, the property of decentralization in dApps is a double-edged sword as it poses usability challenges that could slow down acceptance by the general public (Saldivar et al., 2022). The decentralized structure of dApps often results in complicated interfaces and interactions. Users coming from centralized applications find dApps to be more challenging and, consequently, they may face difficulties in understanding and carrying out their tasks. A survey on the usability of the KDEX decentralized exchange application revealed significant usability issues, thereby, highlighting the necessity of employing more user-centered design methods in developing dApps (Saldivar et al., 2022).

Not to mention, the use of blockchain in metaphors and interactions with money transfers will hardly change the old way of thinking. Even such simple things as a wallet, private keys, and transaction confirmations are hard to grasp. An interesting thing is that even

tech-savvy people might still get very frustrated using blockchain-based applications. Thus, it implies the need for better design strategies (Saldivar et al., 2022). The answer to these issues lies in the adoption of user-centric design principles by the developers where the user experience is the most important thing. This involves a lot of usability evaluations such as heuristic analyses and user testing that will assist in detecting and solving problems in interfaces. Furthermore, the onboarding process can be more explicit and brief so that the users will be educated on the various aspects of dApps thus reducing the mental burden and improving the usability (Jang et al., 2020). Inherent to the blockchain technology is the importance of its simplification, which entails the elimination of complexity. A typical example here is, when the technicalities associated with the transaction management are abstracted, and even user-friendly interfaces to dApps are provided, the acceptance of dApps would then be widely spread. A research conducted on cryptocurrency wallets indicated that both desktop and mobile-based wallets had very poor usability in carrying out basic tasks, thereby indicating the necessity for radical improvement in user interface design (Moniruzzaman et al., 2020).

A user will need to have a deep understanding of the DApp's principles and possess expert skills to be able to use it effectively (Pereira et al., 2019). The learned skill sets and the increased knowledge bases will be of great help in the future for the developers and the users as they will be the ones who will be dealing with the DApp's creation and usage complexities (Wijesekara & Gunawardena, 2023). The study is aimed at finding out how individual users can cut down and even bypass the complexity of decentralized applications by developing the very essence of blockchain technology and improving their practical skills at the same time. This research paper elaborates on the role of information, education, guidance, and skills development in making the user more confident in the use of blockchain technology and also points out that behavioral intent studies can be employed for the purposes of blockchain adoption (Singh et al., 2023). Many research studies have examined this issue of cognitive elements on users' decisions to use dApps and their familiarities with decentralized infrastructure (Marikyan et al., 2022; Pereira et al., 2019; Zhang et al., 2023).

This research, will measure the user experience with centralized application. Therefore, Daraz.pk is selected for this experiment. In this application, the user will perform certain tasks, such as selecting a product, order placement, and performing a transaction. In the next step, dApps will be presented in front of the same user and ask them to perform tasks such as creating their digital wallet (metamask), connecting this wallet with decentralized platform or application, and transacting through this wallet. In this step, the user experience will be evaluated through a survey and ask users whether they need any kind of help or guidance. This experiment will also help us make comparative analysis of the complexity level between centralized and decentralized applications.

In the next step of this research, a training session will be conducted via live or recorded videos (YouTube) (Au Tech, 2025; MoneyZG, 2021; What Is Decentraland?, n.d.; What Is MetaMask?, n.d.). This training, will provide the user with basic knowledge about blockchain technology, decentralized applications, and skills, such as making digital wallet (MetaMask), connecting this wallet with a decentralized platform or application, and transaction through this wallet. At this stage, user experience will be re-examined, and will try to understand the impact of user education and skills in reducing the complexity of blockchain-based decentralized applications. To offer significant contributions to the current discussion regarding the successful implementation and use of decentralized applications based on blockchain technology, this study examines the relationship between knowledge, competence, and trust in the context of decentralized blockchain applications.

1.1. Centralized Website

Daraz.pk: is a leading online retailer, with significant market dominance and brand recognition. Its strategic marketing decisions and affiliations have expanded its reach and strengthened brand reputation. With a consistent user base of 9.1 million, Daraz.pk maintains its top position in the market. The website's user-friendly design contributed to an average visit duration of 5 min 6 s, with each visitor viewing 4.49 product pages. Direct website access accounts for over 34% of the customer base, demonstrating strong brand loyalty. Social media and referrals played minor roles in customer acquisition. Most visitors arrive via search engines, specifically searching for Daraz.pk(Hamid et al., 2024). The web interface of Daraz.pk is show in figure 01.

Figure 1: User Interface of Daraz.pk website (Online Shopping in Pakistan: Fashion, Electronics & Groceries - Daraz.Pk, n.d.)

1.2. Decentralized Websites

Three most popular Blockchain based decentralized applications or platforms

For this research, the three most popular blockchain based decentralized applications or platforms are considered

1.2.1. Uniswap

Uniswap Decentralized token swaps are enabled on Ethereum's blockchain using a set of automated market-making algorithms that are specifically designed to match buyers and sellers in a peer-to-peer setting without the involvement of a middleman (Truong et al., 2023). Thus, no centralized exchanges are needed, which ensures a more efficient and secure trading experience for users. The uniswap.org website interface is shown in figure 02.

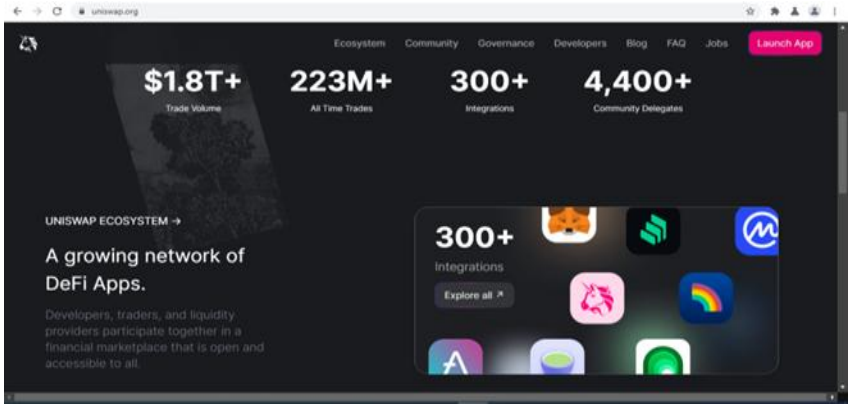

Figure 2: User Interface of Uniswap.org Website (Uniswap Interface, n.d.)

1.2.2. Decentraland

Implements the use of blockchain technology for the ownership of virtual land, transfer of assets, and management of digital assets within a decentralized metaverse (Schär,

2021). In addition to buying and selling virtual land and assets on the platform, users can create and manage their digital identities, engage in social media activities, shop, and play games on the platform. Other than this, users can produce many virtual products and services that can be sold on the virtual market and it can be a source of income. decentraland.org website interface is shown in figure 03.

Figure 3: User Interface of decentraland.org Website (Welcome to Decentraland, n.d.)

1.2.3. MakerDAO

MakerDOA is a decentralized platform like a digital bank that works on Ethereum networks. By using smart contracts this platform facilitates stablecoin and collateralized loan issuance (Chaleenutthawut et al., 2024). This allows users to access the digital currency called stablecoins, which is like a real currency such as fiat currencies or commodities. The web interface of makerdao.com website is shown in figure 4.

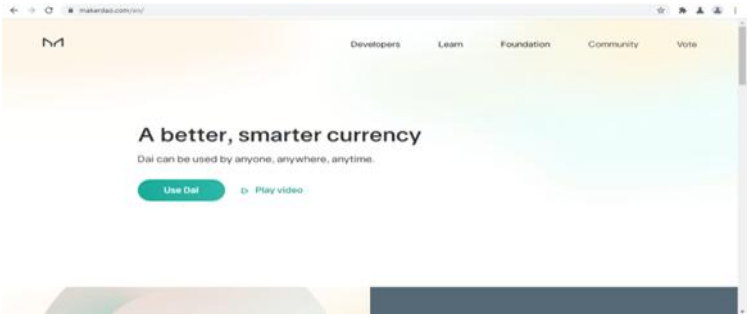

Figure 4: User Interface of makerdao.com Website (MakerDAO | An Unbiased Global Financial System, n.d.)

Due to inherent complexity of blockchain technology there is a huge challenge for user to interact with dApps because user faces different confusions during the navigation of dApp. It is important to known the level of complexity with respect to centralized applications. Without this comparison it is not possible to develop a user-friendly interface of dApps. In continuation of this complexity issue it is also very important to know the user education and skills impact on reducing the complexity. This research will focus on these both points and will find out that will help in feature research.

The purpose of this study is to make a comparative analysis between centralized and decentralized application complexity level in context of user interaction. This research will also focus at what stage user needs help during the utilization of dApp in form of education knowledge and skills. The second purpose of this study is to know the impact of education, knowledge, guidance and skills provided to user of dApp in reduction of complexity problem. With this knowledge guidance and skills how much user gains confidence and understandability?

The format or structure of this paper is as follows: First, the introduction is given, then the second section deals with the related work (Literature Review), the third section

describes the research process (Methodology), the fourth section presents survey results and discussion, and finally, the conclusion (Conclusion) in which a general summary of the entire research is given.

2 Literature overview

This literature review is based on research studies that examine the relationship between usability, complexity, user education, expertise, and trust of blockchain and decentralized applications (DApps). The purpose of this review is to understand how previous research has addressed the complexity issue, what aspects have been addressed, and what areas require further research. In light of these studies, the current study attempts to examine the effects of user education, awareness, and practical training in the context of reducing the complexity encountered in the use of dApps.

Cognitive Complexity, Self-Efficacy and User Education in Technology Adoption

Cognitive complexity in interactive systems is characterized as the amount of mental effort that users have to put in order to comprehend, trace the application, and finally, use it. If we look at undeveloped technologies, the situation is such that the high cognitive load and unclear user mental models are the main obstacles for the users to adopt them (Jang & Jang et al. 2017). One of the researches reveals that e.g. dApps users first faced a hurdle of "users had to create a new mental model" during the process of switching from the already known and hence, comfortable, banking-style interfaces to those based on the blockchain (Jang et al., 2020).

2.1. Adoption of Blockchain and dApps

Research concerning the adoption of blockchain technology and decentralized applications has pointed out a variety of psychological and usability hurdles. For example, a study on user-acceptance in developing regions through the Technology Acceptance Model (TAM) and Innovation Diffusion Theory (IDT) discovered that the factors of perceived usefulness, perceived ease of use, and personal innovativeness are the main determiners of adoption intention (Bernard Ofosu Boateng et al., 2023).

In like manner, a research study that looked into the social and end-user hurdles of blockchain discovered that usability and mental models are under-researched but very important for the acceptance of blockchain to the mainstream market (Virani, 2024).

Jang et al. (2017), through a combination of heuristic and user tests, investigated a decentralized exchange and pointed out usability problems closely tied to wallet integration, unfamiliarity with transaction flows, and people expecting the same from the decentralized exchange as from "traditional" apps (Virani, 2024).

The findings of these studies highlight how the mental strain associated with using the new system (e.g., learning new transactions, wallet operations, confirmations) and lack of education for the users result in decreased adoption rate.

2.2. Usability and Interaction Design in dApps

Through the lens of ISO 9241-210:2019, human-centered design interaction principles like consistency, visibility of the system status, user control, and error recovery are significantly responsible for complexity reduction. In the case of dApps, it is quite the opposite as the blockchain makes users go through additional steps (wallet creation, gas fees, confirmations) that are not required in the case of a centralized app thus raising users' cognitive load. For instance, Wu et al. (2019) in "A First Look at Blockchain-based Decentralized Applications" put forward the argument that only a small percentage of dApps get wide user acceptance which is partly due to users' skill/knowledge deficiency in understanding them (Wu et al., 2019).

In addition, the usability research reveals that the majority of dApp investigations are concerned with developer tools instead of the end-user interaction aspect (Jang et al. is one such reference)(Wu et al., 2019).

The above-mentioned studies further affirm that cognitive overload (new transactions, wallet operations, confirmations, etc.) and insufficient user education are the two main factors hindering the adoption process.

2.3. Role of User Education and Self-Efficacy

User education, training, and guidance have been reported to have a positive effect on self-efficacy, which then affects the user's perception of the system's usability and their intention to use it. The literature in the area of general ICT adoption has revealed that it is mainly through training that self-efficacy gets improved and cognitive load reduced; however, not so many studies have been done in the area of blockchain/dApp to support this. A few TAM-based studies in the field of blockchain say that "awareness and education campaigns need to be created by organizations and governments to increase adoption." (Bernard Ofosu Boateng et al., 2023)

2.4. Research Gap

Majority of the existing research done on the adoption of blockchain technology has been looking at it from the point of view of general factors such as usefulness, ease of use, and innovativeness, while only a few studies are there that discuss cognitive complexity and its variance in centralized versus decentralized applications. Research hardly investigates whether properly designed user education or training can make a difference in self- efficacy, perceived ease of use, or actual adoption behavior in the case of dApps. Also, there are not many empirical studies that look at the relationship of cognitive load reduction and usability in blockchain interfaces and integration of psychological factors like self-efficacy and interaction design standards like ISO 9241-110 is rarely done in current design frameworks. This research contributes to filling these gaps by doing a comparison between centralized and decentralized applications and by assessing how education and guidance can boost user confidence, comprehension, and acceptance.

3 Methodology

The methodology of the research comprises a multi-dimensional approach to assess the user experience and adoption of decentralized applications (dApps) in relation to traditional mobile applications. Basically this research will adopt three main steps to achieve the research object. The first step is to evaluate the level of complexity between centralized and decentralized applications in the context of user interaction. This will tell us whether the user needs any help, guidance, or direction while using these two apps. This assessment will be down through survey.

In the next step, two main tasks will be performed. The first is the assessment of user knowledge about blockchain, dApp, and user confidence level. The second task of this step is the measurement of user experience on dApp based on their current knowledge and confidence.

In the third and final step, user will receive basic knowledge, Information and expertise or skill in blockchain technology through live or recorded video formats. And then will again evaluate the user experience their level of confidence and will estimate how much user education, knowledge, and skills have had an impact on reducing complexity. The complete flow of methodology is shown in figure 5.

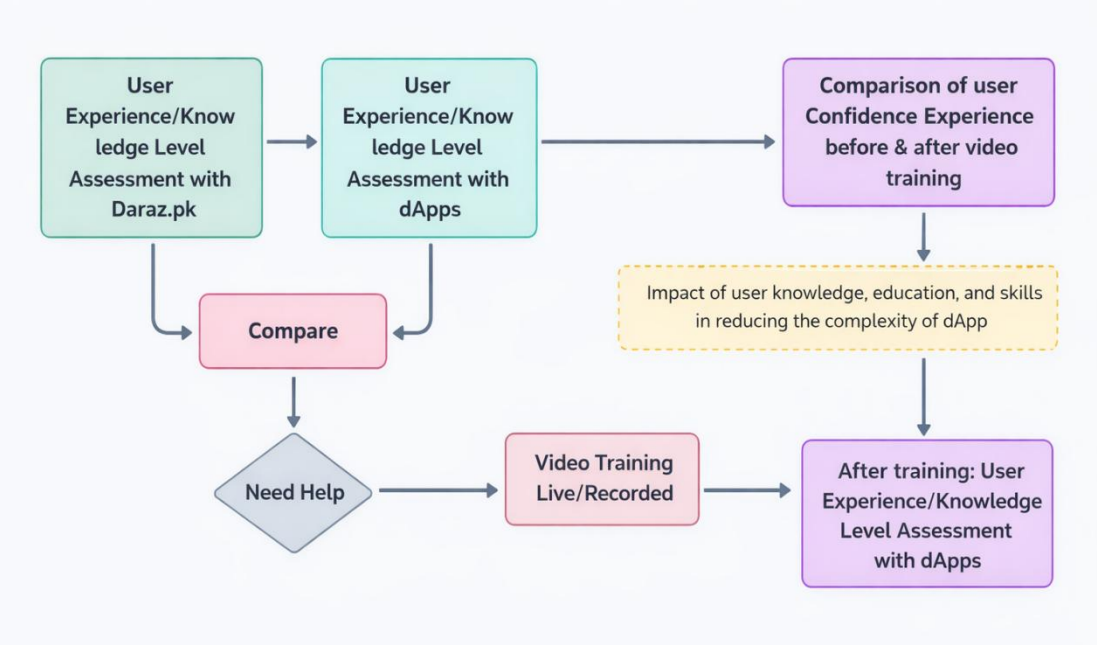

Figure 5: Complete Structure of Research

3.1 Data collection

Both physical and online survey forms are utilized for data collection purpose Approximately There are about 200 respondents who participated in this study. The five-point Likert scale questionnaire via Google forms (Akram et al., 2023) also contains the links of videos for training purpose is shared to evaluate the user experience of centralized and decentralized application before and after training. After that, the collected data is examined to realize how education, knowledge experience, and skill levels affect the acceptance of decentralized apps (dApps) built on blockchain technology. This data was collected through a Google Forms survey (Impact of Knowledge and Skill in Reducing Complexity and Enhancing Confidence in Blockchain-Based Decentralized Applications Adoption, n.d.).

3.2. Research Question

1. How much more complex is a dApp than a centralized app in terms of user interaction?
2. During the use of dApp, does the user feel the need for any help, direction, or guidance?
3. If proper education, guidance, knowledge, and skills are provided to the user, then what impact will it have on the reduction of complexity issue, and how much user confidence will be enhanced?

3.3. Survey Structure

This survey consists of two parts, one before and one after the video training. And each part of them stands on three pillars. The first pillar of the first part of the survey is awareness and familiarity. The function of this part of the survey is to evaluate the user experience with a centralized app and also assess the user's current experience with decentralized apps.

The second pillar of the first part of this survey is knowledge assessment. This section will review the user's current knowledge level of blockchain technology and blockchain-based decentralized applications to perform some specific descriptive operations on dApps.

The third pillar of the first survey is skills assessment. At this level, the participants will perform some specific actions on selected three dApps (Uniswap, Decentraland, and MakerDAO), such as making a wallet (MetaMask), conducting transactions, integrating digital wallets with dApps, and connecting to decentralized platforms. This stage will also

assess whether he or she needs any additional guidance, direction, or skills during the use of dApps. The structure of survey is completely explained in figure 6.

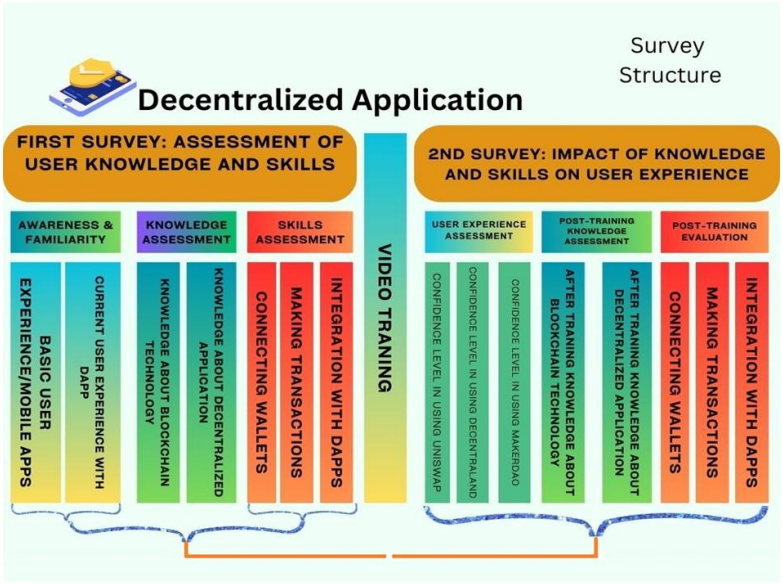

Figure 6: Structure of survey

3.4 Selection of Parameters

- People from different background particularly students of different colleges and universities from different part of the world
- Participants of all ages, specially students, should be between the age of 18 to 35
- In addition to men, the participation of women should be ensured
- Participants are being familiar with daraz.pk app or similar app but never use this app.
- Participants do not to have any previous dApp experience.

4 Survey Results

The responses of Demographic section of survey

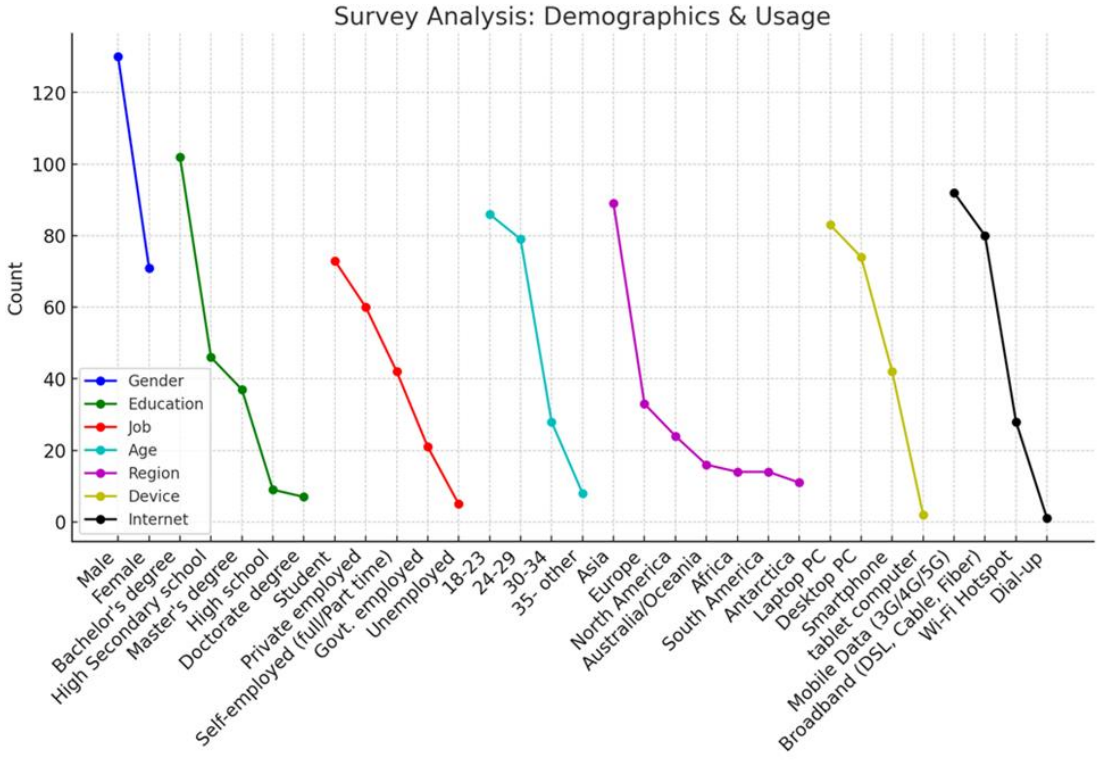

Figure 7: All Demographic Responses about participants

The bar chart illustrates in figure 8, user feedback regarding their experience with Daraz.pk, a centralized shopping application. It indicates various factors like users' familiarity with Daraz.pk, ease of use, satisfaction with ordering, comprehension of transactions, overall experience, and whether they needed assistance in using the application. Most users declared that the application was simple for them to use and order, but few required help. The varied responses by category corresponded to differing experiences with some users having a smooth process while others faced difficulties.

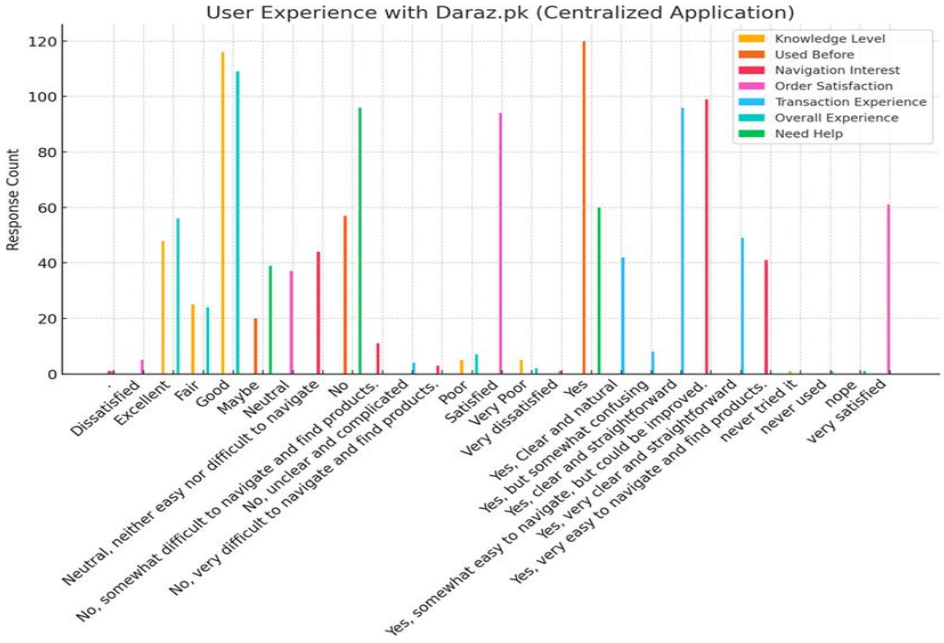

Figure 8: User Experience and Usability of Daraz.pk: Insights from Survey Responses

The 3D chart in figure 9, shows the user responses regarding decentralized applications (dApps) before training. The majority of users needed support during the dApps usage, thus indicating that they were not familiar with it. The familiarity with Uniswap and Decentraland was not the same across the participants, some had heard about these platforms and others had not. Users' total self-assurance in managing both Uniswap and Decentraland was very low, which indicated that users found dApps difficult before the training began. The results underline the importance of user training in boosting dApp usability and adoption.

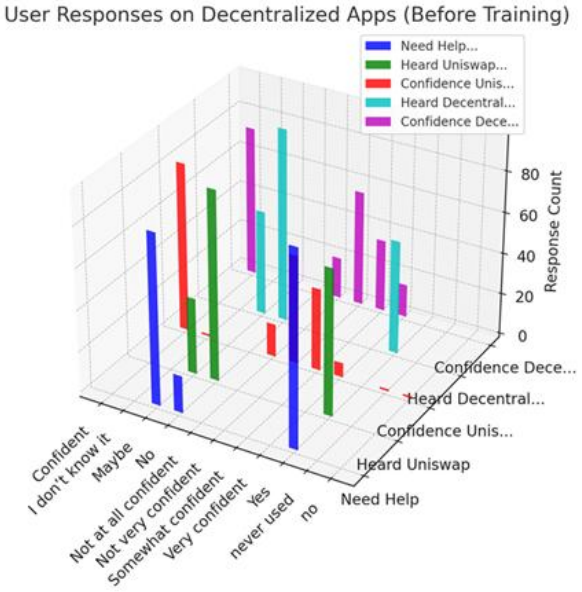

Figure 9: User Awareness and Confidence in Decentralized Applications (dApps) Before Training

The pie chart in figure 10 illustrates the increase of users' trust, knowledge, and wallet integration capability after getting acquainted with decentralized applications (dApps). The specific characteristics of the visualization cover the changes in transaction capacity and wallet as well as the confidence level of using MakerDAO, Decentraland, and Uniswap. The graph indicates that the majority of respondents had good outcomes; their confidence and usability were the most noticeably improved areas. The success of the integration showed also that teaching helped people to get a clearer picture of the process. The picture clearly indicates which areas had the most remarkable development and thus helped identifying the strengths and the possible next steps.

5 Results Analysis

The survey data discuss how online training videos improve user knowledge and abilities. The investigation first compares Daraz.pk, a central application, with three different dApps to determine where users may need help in order to use the app effectively, as per the survey design. This analysis also considers user experience in both sorts of apps. Furthermore, the research looks into variations in consumer trust when using dApps prior and after instruction. It then assess the user's confidence in incorporating a digital wallet with dApps either before or after training.

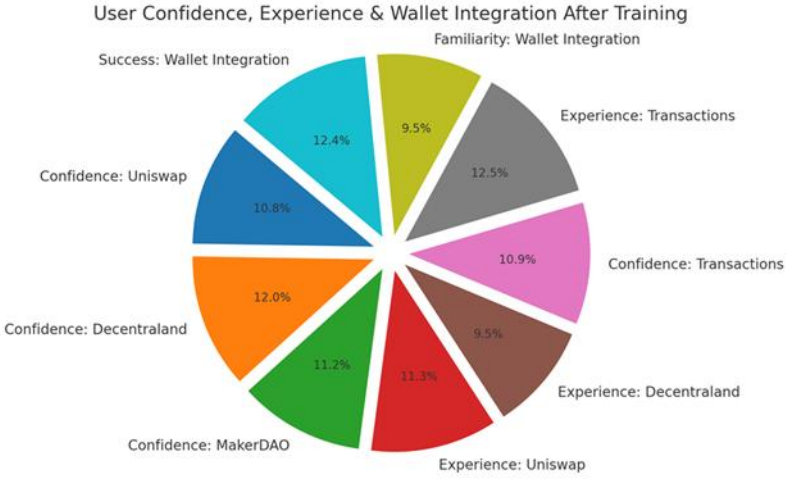

Figure 10: User Confidence, Experience, and Wallet Integration Improvements After Training in dApps

Table 1: Comparison of user needs help during the use of Daraz.pk and dApps

Apps	Maybe	No	Yes
Daraz.pk	39	96	60
dApps	83	18	95

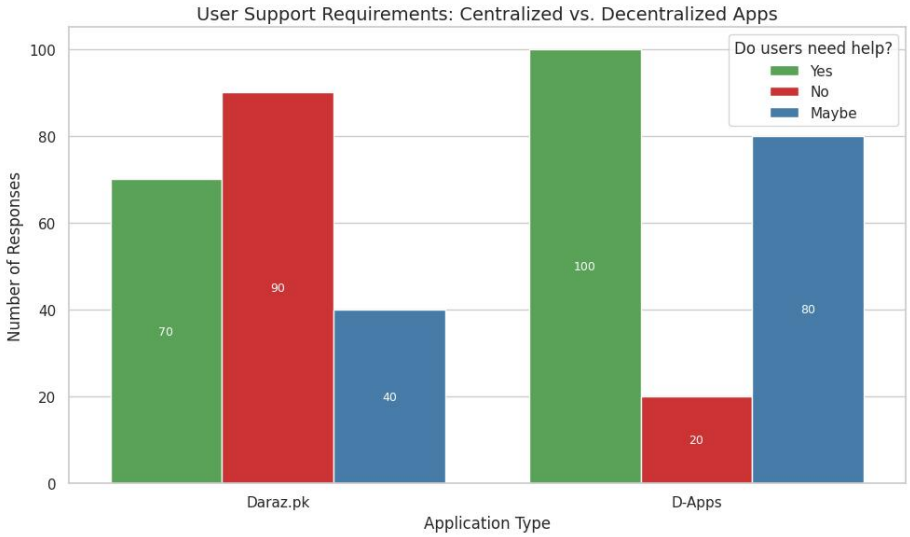

Figure 1 1: Comparison of user needs help during the use of Daraz.pk and dApps This table-1 shows the counts of responses for the need for help or guidelines during the use of Daraz.pk and dApps. In the above comparison table, the responses (83) of dApp are shown as "maybe" votes, which shows that users are unsure and confused about the usage of dApp. The main reason is the lack of knowledge and information about dApps, and which is difficult to use. However, there were more positive (yes) and fewer negative (No) responses to dApp. These results indicate that using dApps is complex and user needs support and guidance as shown in figure 12.

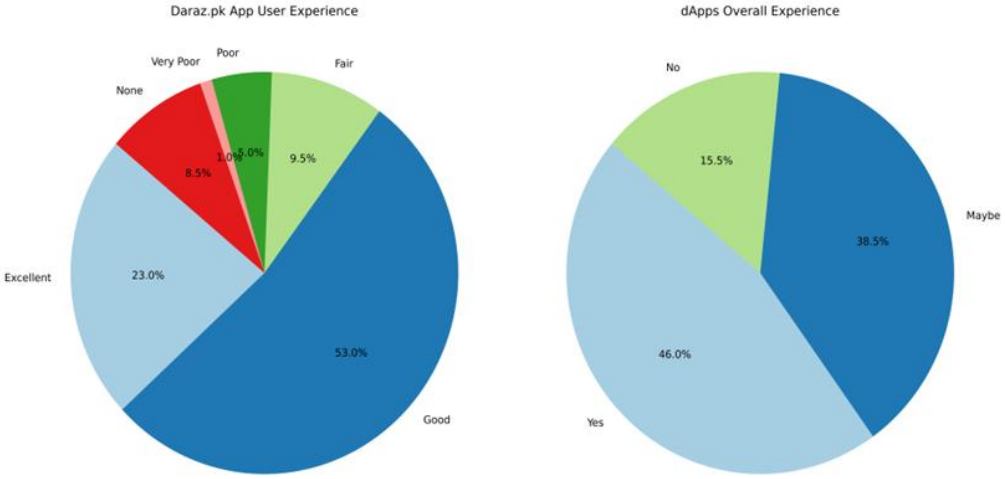

Figure 12: Comparison of overall user Experience of Daraz.pk and dApps

Table 2: Comparison of overall user Experience of Daraz.pk and dApps

	Daraz.pk Experience	dApps Experience
Excellent	56	0
Fair	24	0
Good	109	0
Maybe	0	83
No	0	18
Poor	7	0
Very Poor	2	0
Yes	0	95
nope	1	0

Here the data in above table-2 shows the comparative analysis between the user experiences with the Daraz.pk app and their need for help or guidelines when using dApps. The ratings for Daraz.pk are distributed across three categories: Excellent (56 responses), Fair (24 responses), and Good (109 responses). There are no responses for 'Maybe' or 'No'. The responses for dApps are concentrated in the 'Maybe' (83 responses) and 'No' (18 responses) categories, with no responses in the 'Excellent', 'Fair', or 'Good' categories.

Daraz.pk seems to have a generally positive reception with a significant number of 'Good' ratings. dApps, on the other hand, shows a tendency towards uncertainty or

dissatisfaction among users, as indicated by the high number of 'Maybe' responses and some 'No' responses.

This comparison highlights a stark contrast in user experience between the two platforms, suggesting that Daraz.pk might be more favorably viewed than dApps based on the available data. Because for dApps user need help or guidance so there is clear demand for training conducted through online or recorded videos as it can be seen in figure 13.

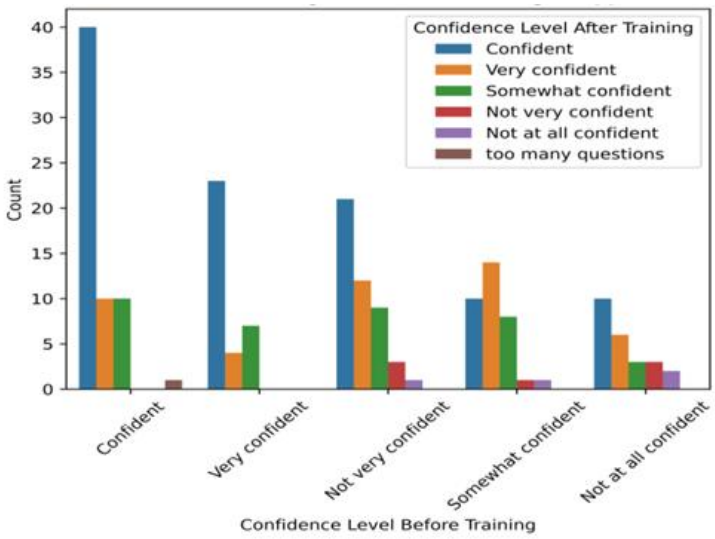

Figure 1 3: Comparison of user confidence in making transaction through dApps before & after training

Table 3: Comparison of user confidence in making transaction through dApps before & after training

Before training level of confidence in making transactions through d Apps?	After the training, Level of confidence in making transactions through dApps?	Count
Confident	Confident	40
Very confident	Confident	23
Not very confident	Confident	21
Somewhat confident	Very confident	14
Not very confident	Very confident	12
Confident	Very confident	10
Not at all confident	Confident	10
Somewhat confident	Confident	10

Confident	Somewhat confident	10
Not very confident	Somewhat confident	9
Somewhat confident	Somewhat confident	8
Very confident	Somewhat confident	7
Not at all confident	Very confident	6
Very confident	Very confident	4
Not at all confident	Somewhat confident	3
Not at all confident	Not very confident	3
Not very confident	Not very confident	3
Not at all confident	Not at all confident	2
Not very confident	Not at all confident	1
Somewhat confident	Not at all confident	1
Somewhat confident	Not very confident	1
Confident	too many questions	1

Another important aspect this research aims to uncover the impact of pre and post training on user confidence in transactions through decentralized applications (dApps). The obtained data in table 3 shows that, many users felt confidence (40) or very confident (14), and small number of users felt they were very confident, not confident (21) or not confident at all (10). However, some user went from somewhat confident to very confident (14), indicates that the training had positive effect on them. Overall, training appears to have helped increase user confidence in transaction through dApps, which was low before training as shown in figure 14.

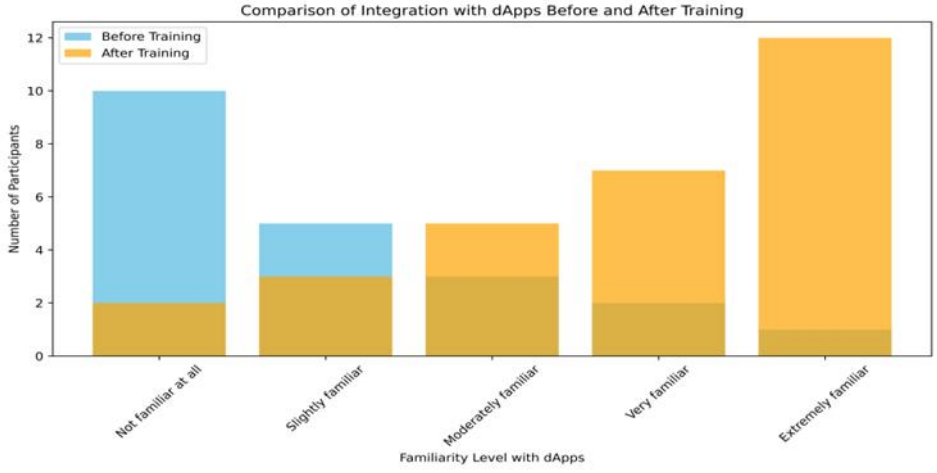

Figure 14: Comparison of wallet integration with dApps before & after training

Table 4: Comparison of wallet integration with dApps before & after training

Familiarity Level	Before Training	After Training
Not familiar at all	10	2
Slightly familiar	5	3
Moderately familiar	3	5
Very familiar	2	7
Extremely familiar	1	12

The table 4 shows a significant improvement in familiarity with decentralized applications (dApps) after training. Before training, most participants were not familiar at all (10) or only slightly familiar (5) with dApps. After training, the number of participants not familiar at all decreased to 2, and those slightly familiar decreased to 3. Additionally, familiarity levels increased, with 7 participants becoming very familiar and 12 becoming extremely familiar with dApps. This indicates that the training effectively increased participants' understanding and familiarity with dApps.

All these results can be summarized in a way that only 28% of users needed help while using Daraz.pk, while 95% of users needed guidance or explanation while using dApps. This is mainly due to the complex interface of blockchain apps, digital wallet integration and transaction verification steps. In the second part of the study, users were shown videos on YouTube that taught them how to create blockchains, MetaMask wallets, make transactions, and connect to dApps. After the training, users' confidence, understanding, and skills significantly increased. 74% of users expressed confidence in transactions, awareness of dApps increased from 20% to 80%, and wallet integration success reached above 70%, indicating that the training produced a clear improvement in user performance.

5.1. **Psychological impact of training intervention**

The survey results reveal that a considerable alteration had taken place in the behavior and psychological state of the users after the training compared to before. Most of the users reported stress, confusion, and uncertainty as their emotions while using decentralized applications at the outset. Nevertheless, structured training via educational videos solicited a notable beneficial change in users' confidence, familiarity, and sense of control. Thus, post-training, there were 74% users who expressed higher self-assurance during dealings, and the rate of dApps cognizance went up from 20% to 80%. The findings have shown (figure 15) very well that better user education and technical skills lessen mental strain, elevate the view of the system being easy to use, and hence the technology is accepted more.

Figure 15: Behavioral impact of training on dApp Usability

6 Conclusions

The main objective of this research was to understand the differences in user experience and the reasons for the complexity of blockchain-based dApps by comparing

centralized and decentralized applications. Daraz.pk was chosen as the central application for the experiment, while the decentralized platforms included Uniswap, Decentraland, and MakerDAO. In the initial phase of the research, 200 users who had no prior practical experience with dApps were surveyed. Overall, the results show that the complexity of blockchain apps is a major barrier for users, but proper training significantly reduces these issues. Users' awareness of dApps, transaction confidence, and wallet integration ability significantly increased after the training videos. This proves that step-by-step guidance makes dApps more understandable and usable for new users. These outcomes indicate that ongoing user education, raising awareness, and providing practical training make it less complex to use blockchain-powered dApps. The research also pointed out that users essentially needed both cognitive and operational guidance to navigate through dApps and understand the interface. When both these aspects are taken care of, user confidence rises, experience becomes better, and the technology adoption likelihood also increases. Based on these findings, more interactive and personalized training modules can be developed for blockchain-based dApps in the future to provide more practical convenience to new users. dApps can be made more simple and understandable by adding AI-based guides, chat support, and automated error handling.

As a result, this study indicates that it is very important for the designers and developers of blockchain applications to consider user education as an important factor of the interface design. This method does not only make it easier for the user but also contributes significantly to the gaining of acceptance and trust in blockchain technology.

Future Work

Through the complete experimental procedure, three main types of complexities in decentralized applications (dApps) were revealed which are major hurdles for the new users. Complexity of the visual UI is the first one, difficulty of navigation is the second one, and the dApp's structural complexity is the third one. These complexities together block users' way to adoption and effective utilization of dApps. Consequently, it is of utmost importance that new users during the onboarding period are given basic, critical, and necessary information and skills in order to lessen these barriers and make the adoption process of dApps easier.

Acknowledgment

The leading author is thankful to the Departement of Computer Science, Superior University Lahore, 54000, Pakistan.

References:

Akram, M., Waseem Iqbal, M., Usman Ashraf, M., Arif, E., Alsubhi, K., & Moaiteq Aljahdali, H. (2023). Optimization of Interactive Videos Empowered the Experience of Learning Management System. Computer Systems Science and Engineering, 46, 1021–1038. https://doi.org/10.32604/csse.2023.034085

Au Tech (Director). (2025, June 11). How to Connect Uniswap to Metamask Wallet (Easy 2025) [Video recording]. https://www.youtube.com/watch?v=aPGjP7W4k2Q

Bernard Ofosu Boateng, Charles Asare, & Kwame Ntim Sekyere. (2023). Understanding Blockchain Adoption In Emerging Markets: Integrating The Technology Acceptance Model And Innovation Diffusion Theory. International Journal of Entrepreneurship, 27(5). https://www.abacademies.org/articles/understanding-blockchain-adoption-in-emerging-markets-integrating-the-technology-acceptance-model-and-innovation-diffusion-theory-16141.html?utm_source=chatgpt.com

Chaleenutthawut, Y., Davydov, V., Evdokimov, M., Kasemsuk, S., Kruglik, S., Melnikov, G., & Yanovich, Y. (2024). Loan Portfolio Dataset From MakerDAO Blockchain Project. IEEE Access, 12, 24843–24854.

https://doi.org/10.1109/ACCESS.2024.3363225

Hamid, K., Ibrar, M., Delshadi, A. M., Hussain, M., Iqbal, M. W., Hameed, A., & Noor, M. (2024). ML-based Meta-Model Usability Evaluation of Mobile Medical Apps. International Journal of Advanced Computer Science and Applications, 15(1). https://doi.org/10.14569/IJACSA.2024.0150104

Impact of Knowledge and Skill in Reducing Complexity and Enhancing Confidence in Blockchain-Based Decentralized Applications adoption. (n.d.). Google Docs. Retrieved November 14, 2025, from https://docs.google.com/forms/d/e/1FAIpQLSc45q_DaZhhLF2Qu2TtVriGXsy1HFOPiv0cXLJKsPZ5f61jw/viewform?usp=sf_link&usp=embed_faceb ook

Jang, H., Han, S. H., & Kim, J. H. (2020). User Perspectives on Blockchain Technology: User-Centered Evaluation and Design Strategies for DApps. IEEE Access, 8, 226213–226223. https://doi.org/10.1109/ACCESS.2020.3042822

MakerDAO | An Unbiased Global Financial System. (n.d.). Retrieved November 14, 2025, from https://makerdao.com/en/https://makerdao.com/en

Marikyan, D., Papagiannidis, S., Rana, O. F., & Ranjan, R. (2022). Blockchain adoption: A study of cognitive factors underpinning decision making. Computers in Human Behavior, 131, 107207. https://doi.org/10.1016/j.chb.2022.107207

MoneyZG (Director). (2021, February 15). Uniswap Tutorial for Beginners—How to Use Uniswap DeX [Video recording]. https://www.youtube.com/watch?v=JSp6wTyOGEQ

Moniruzzaman, M., Chowdhury, F., & Ferdous, M. S. (2020). Examining Usability Issues in Blockchain-Based Cryptocurrency Wallets. In T. Bhuiyan, Md. M. Rahman, & Md. A. Ali (Eds.), Cyber Security and Computer Science (Vol. 325, pp. 631–643). Springer International Publishing. https://doi.org/10.1007/978-3-030-52856-0_50

Online Shopping in Pakistan: Fashion, Electronics & Groceries—Daraz.pk. (n.d.). Retrieved November 14, 2025, from https://www.daraz.pk/#?

Pereira, J., Tavalaei, M. M., & Ozalp, H. (2019). Blockchain-based platforms: Decentralized infrastructures and its boundary conditions. Technological Forecasting and Social Change, 146, 94–102. https://doi.org/10.1016/j.techfore.2019.04.030

Saldivar, J., Martínez, E., Rozas, D., Valiente, M. C., & Hassan, S. (2022). Blockchain (Not) for Everyone: Assessing the User Experience of Blockchain-Based Applications. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.4154040

Schär, F. (2021). Decentralized Finance: On Blockchain- and Smart Contract-Based Financial Markets. Review, 103(2). https://doi.org/10.20955/r.103.153-74

Singh, Y., Jabbar, M. A., Kumar Shandilya, S., Vovk, O., & Hnatiuk, Y. (2023). Exploring applications of blockchain in healthcare: Road map and future directions. Frontiers in Public Health, 11, 1229386. https://doi.org/10.3389/fpubh.2023.1229386

Truong, V. T., Le, L., & Niyato, D. (2023). Blockchain Meets Metaverse and Digital Asset Management: A Comprehensive Survey. IEEE Access, 11, 26258–26288. https://doi.org/10.1109/ACCESS.2023.3257029

Uniswap Interface. (n.d.). Retrieved November 14, 2025, from https://app.uniswap.org/

Virani, S. S. (2024). Blockchain end user adoption and societal challenges: Exploring privacy, rights, and security dimensions. IET Blockchain, 4(S1), 691–705. https://doi.org/10.1049/blc2.12077

Welcome to Decentraland. (n.d.). Retrieved November 14, 2025, from https://decentraland.org/

What Is Decentraland? (n.d.). Built In. Retrieved March 27, 2025, from https://builtin.com/articles/what-is-decentraland

What Is MetaMask? | Beginner's MetaMask Tutorial In 2025! (n.d.). [Video recording]. Retrieved November 14, 2025, from https://www.youtube.com/watch?v=-

HTubEJ61zU
Wijesekara, P. A. D. S. N., & Gunawardena, S. (2023). A Review of Blockchain Technology in Knowledge-Defined Networking, Its Application, Benefits, and Challenges. Network, 3(3), 343–421. https://doi.org/10.3390/network3030017
Wu, K., Ma, Y., Huang, G., & Liu, X. (2019). A First Look at Blockchain-based Decentralized Applications (Version 1). arXiv. https://doi.org/10.48550/ARXIV.1909.00939

Zhang, Q., Khan, S., Khan, S. U., & Khan, I. U. (2023). Understanding Blockchain Technology Adoption in Operation and Supply Chain Management of Pakistan: Extending UTAUT Model With Technology Readiness, Technology Affinity and Trust. Sage Open, 13(4), 21582440231199320. https://doi.org/10.1177/21582440231199320

Zheng, P., Jiang, Z., Wu, J., & Zheng, Z. (2023). Blockchain-Based Decentralized Application: A Survey. IEEE Open Journal of the Computer Society, 4, 121–133. https://doi.org/10.1109/OJCS.2023.3251854