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Perceived Usability of a Blockchain Lab for Blockchain Learning, Research and Innovation in Tanzania

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Abstract
Blockchain technology has gained global attention for its potential to transform data management and service delivery across industries. However, adoption in developing countries, such as Tanzania, has been limited, largely due to gaps in knowledge, technical skills and accessible training environments. To address this challenge, Dinari, a blockchain learning lab, was developed to provide users with a platform to explore, practice and apply blockchain concepts in support of education, research and innovation in Tanzania. The study evaluated the usability of the Dinari lab, using the System Usability Scale (SUS), a standardized instrument for assessing user experience. A total of 112 participants engaged with the lab and completed the SUS questionnaire. The platform achieved a mean score of 72.4, which falls within the good usability range and is above the average benchmark of 68. The study concludes that the lab can play a valuable role in advancing blockchain education, supporting research initiatives, and promoting innovation in Tanzania.

Keywords: Blockchain Lab; system usability evaluation; system usability scale.

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Introduction

Blockchain is a distributed ledger technology that stores data chronologically along with its ownership history. Over the past decade, it has attracted widespread global interest because of its potential to transform the way information is stored, exchanged and secured in digital ecosystems (Gad et al., 2022). For instance, the total market capitalization of cryptocurrencies was estimated at about USD 1.2 trillion as of mid-2023 (Borri & Shakhnov, 2023), demonstrating its rapid growth and adoption. Beyond cryptocurrency and payments, blockchain applications are expanding into diverse industries, such as healthcare (Agbo et al., 2019; Chukwu & Garg, 2020), energy (Andoni et al., 2019; Parmentola et al., 2022), supply chain and logistics (Pournader et al., 2020; Queiroz et al., 2019; Azzi et al., 2019), agriculture (Bermeo-Almeida et al., 2018; Lezoche et al., 2020) and forestry management (He & Turner, 2022), to mention just a few.

Despite this global momentum, adoption in developing countries, including Tanzania, remains slow (Saif et al., 2022). Several factors contribute to the low adoption of blockchain technology in these countries. Saif et al. (2022) group the factors as technological limitations (Kouhizadeh et al., 2021), governance and regulatory challenges (Yadav et al., 2020; Kwok

& Koh, 2019), organizational constraints (Dutta et al., 2020; Lu, 2019; Saheb & Mamaghani, 2021) and knowledge gaps (Li et al., 2019). Among these, lack of knowledge and skills is the most significant, creating difficulties for both awareness and implementation of blockchain-based solution. The lack of knowledge includes either total lack of awareness, partial knowledge or a lack of skilled professionals to implement the technology (Li et al., 2019).

To address this challenge, a study was commissioned to develop an online blockchain lab called Dinari, designed to provide a practical environment for blockchain learning, research, and innovation in Tanzania (Kigombola et al., 2023). Dinari lab enables users to practice core blockchain concepts using a mobile wallet application and a web-based interface. The platform makes blockchain education accessible, thus promoting blockchain learning, research and innovation in Tanzania.

While several global studies have explored blockchain applications across industries, very few have focused on the usability of blockchain learning platforms, particularly in developing country contexts. Most prior works have concentrated on technical deployments, organizational adoption barriers or sector-specific solutions (AlShamsi et al., 2022; Komulainen & Nätti, 2023; Virani, 2024; Kosmarski, 2025; Amien & Zulkarnain, 2025), while relatively fewer studies explored how users interact with blockchain learning labs or training platforms, especially from a usability perspective.

Usability, defined as the degree to which a system can be effectively and efficiently used by its intended users, is a critical factor in ensuring that technological platforms fulfil their educational and research purposes (Shackel, 1986; Abran et al., 2004). This study, therefore, fills the gap by applying the System Usability Scale (SUS) to evaluate the Dinari lab, providing empirical evidence on its effectiveness as a tool for blockchain learning, research and innovation. By focusing on usability, the study contributes to improving user experience, strengthening blockchain literacy and supporting digital innovation in Tanzania. This study was guided by specific resarch questions that appear in the findings section.

Methodology

This study adopted a quantitative survey-based approach to evaluate the usability of the Dinari blockchain lab. The evaluation was conducted using the SUS, a widely recognized instrument for measuring system usability across diverse domains (Brooke, 1996). The SUS was chosen because it is cost-effective, reliable and provides a standardized benchmark for comparing usability across systems, making it especially suitable for emerging technologies in resource-constrained environments such as Tanzania. By systematically evaluating various aspects of the system's usability, the SUS survey enables researchers and developers to gain valuable insights into user satisfaction, efficiency, and ease of use.

Design

This study employed a descriptive survey research design, which is commonly used to collect quantitative data on participants' perceptions of a system in real-world settings. The design allowed the researchers to capture participants' experiences systematically and to generate measurable insights into system effectiveness.

Population and Sampling

The target population consisted of individuals who engaged with the Dinari blockchain lab through either the mobile wallet application or the web interface in Tanzania. The study sample was 112 participants, including university students at the undergraduate and postgraduate levels as well as university staff who volunteered to participate. This mix provided a diverse sample that reflects potential end-users of the platform.

Instruments

The primary instrument for data collection was a System Usability Scale (SUS) questionnaire, consisting of ten items on the five-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5). The items assessed usability dimensions, such as ease of use, integration of functions and user confidence and learnability. In SUS, negative statements are even numbered. In the process, the statistical treatment minuses the user response from five in order to reverse the scoring direction and ensure that all adjusted scores correctly reflect perceived usability. The SUS questionnaire

requested the system users to score the following 10 items:

1. I would like to use this system frequently.
2. I found the system unnecessarily complex.
3. The system was easy to use.
4. I would need the support of a technical person to be able to use this system.
5. I found the various functions in this system well integrated.
6. There was too much inconsistency in this system.
7. Most people would learn to use this system very quickly.
8. I found the system cumbersome to use.
9. I felt confident using the system.
10. I needed to learn a lot of things before I could get going with this system.

Statistical Treatment of Data

Responses were scored according to the SUS procedure established by Brooke (1996): for odd-numbered items, one was subtracted from the user score while for even-numbered items, the user score was subtracted from five. The adjusted values were summed and multiplied by 2.5 to generate a usability score out of 100 for each respondent. Descriptive statistics summarized the results, including the mean SUS score and the distribution of scores across participants. A mean score above 68 was interpreted as above average while those below this threshold indicated usability concerns.

The following steps were used in the SUS score computation.

1. All the items in the SUS questionnaire needed to be responded to. If a respondent did not have an answer to a particular item, they marked the centre point of the scale.
2. For odd-numbered items, one is subtracted from the user response.
3. For even-numbered items, the user response is subtracted from 5.
4. The converted responses for each user are added up.
5. The total is then multiplied by 2.5.

The final score is computed as a mean of scores from all the respondents. A score above 68 is above average usability while scores below 68 indicates usability concerns.

Ethical Considerations

All participants were informed of the purpose of the study and gave their voluntary consent before participation. The survey was conducted anonymously, with no collection of personally identifiable information. Data was stored securely, accessible only to the research team and used solely for academic purposes. Throughout the study, standard ethical research practices were strictly observed, ensuring respect for participants' rights, privacy, and confidentiality.

Findings and Discussion

As observed in Figure 1, experiments were conducted with participants who accessed the Dinari blockchain lab through either the mobile wallet application (available on the Google Play Store) or the web-based interface (Dinari (n.d.).

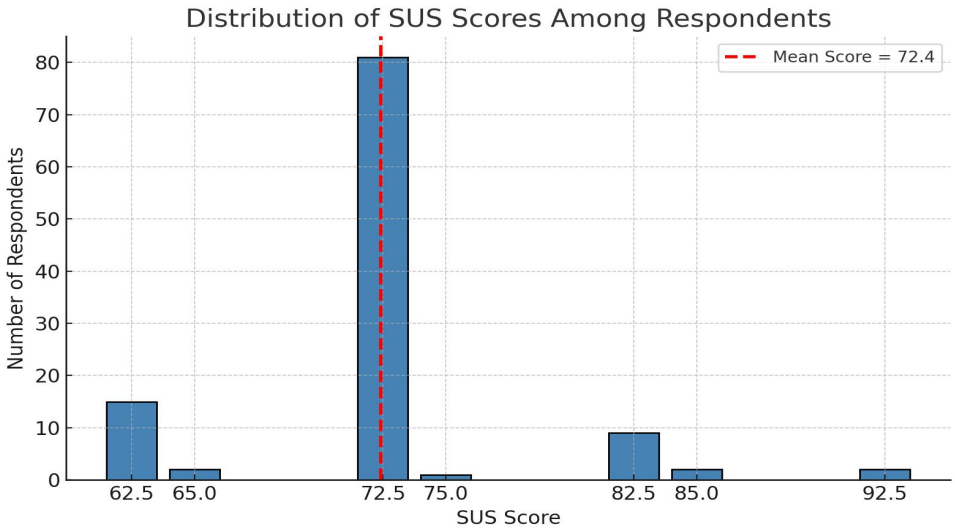

Figure 1: Distribution of SUS Scores Based on the Number of Respondents

After installation, users were asked to perform typical blockchain activities, such as creating accounts, initiating transactions and monitoring transaction histories. These tasks were designed to simulate real usage scenarios and expose participants to the core functionalities of the lab. A total of 112 participants completed the study questionnaire.

Data was collected using a System Usability Scale (SUS) questionnaire, administered through a structured Google Form. Participants were prompted to complete the SUS survey immediately after their interaction with the lab, ensuring that feedback was based on fresh user experiences. The questionnaire responses were automatically stored in a Google Form and later exported into Microsoft Excel for cleaning and analysis. Findings appear in Figure 1.

Research Question1: How usable is the Dinari blockchain learning lab, as measured by the System Usability Scale (SUS) by users in Tanzanian?

A total of 112 participants completed the SUS questionnaire after using the Dinari blockchain lab. The overall mean score was 72.4 with 82 out of 112 participants scoring between 71 and 80, which is above the benchmark of 68, indicating that the system meets the minimum standard for usability (Brooke, 1996). According to the interpretation framework developed by Bangor et al., (2009), SUS scores below 50 are considered poor, scores between 50 and 69 are rated marginal scores, between 70 and 85 are regarded as good, and scores above 85 are considered excellent. In this framework, the Dinari blockchain lab's mean score of 72.4 falls in the good category, confirming that users generally found the system easy to use, consistent and reliable.

A similar study by Supriyadi et al. (2020) obtained a mean score of 55.3, which was rated as below average (Marginal Low) in terms of acceptability. In another similar study in Greece reported a mean score of 76, which show a high level of usability (Orfanou et al., 2015). These findings illustrate that the Dinari blockchain's score of 72.4 reflects a comparatively stronger performance and suitability for blockchain learning, research and innovation. While SUS scale does not explicitly measure learning or innovation, research in educational technology shows that usability strongly correlates with ability to engage, explore and adopt new tools, thereby enabling environments conducive to learning, research and innovation (Vlachogianni & Tselios, 2023)

Previous studies have emphasized the importance of educational platforms to be intuitive and user-friendly for encouraging exploration and reduce learning barriers (Li et al., 2019; Lu, 2019). A systematic review of usability research in educational technology (Lu et al., 2022) highlighted that ease of use, learnability and intuitive design are the most emphasized attributes in learning systems as they reduce barriers, support exploration and enhance students' engagement. Usability plays a pivotal role in determining whether learners and researchers can effectively engage with new technologies. The Dinari blockchain lab's usability score in this study provides such an environment, enabling students, researchers, and innovators to interact with the blockchain technology without steep technical entry barriers. This usability score is important because ease of use enhances learners' motivation and adoption, thereby strengthening blockchain learning, research and innovation (Vlachogianni & Tselios, 2023).

Research Question 2: What areas of improvement can be identified from user feedback to enhance the usability of the Dinari blockchain lab?

Although the overall usability of the Dinari blockchain lab was rated above average, with a mean SUS score of 72.4, placing it in the good usability category, the results show areas that require attention as summarized in Table 1.

Table 1: Respondents Per Usability Score in Ranges

Score	Frequency of Respondents	Percent
0 - 60	0	0
61 -70	17	15.2
71 - 80	82	73.2
81 - 90	11	9.8
91 - 100	2	1.8

Table 1 shows that 15.2% of the participants reported lower usability ratings, indicating that while the majority found the Dinari lab user friendly, some users experienced difficulties while using it.

In Table 2, item 2 and item 5 indicate concerns with the system complexity. These are average scores. These responses suggest that while most users found the lab easy to use, a subset of users experienced difficulties in navigating between features and understanding workflows.

Similar findings have been reported in previous usability studies, which shows that improving navigation consistency and reducing system complexity are necessary to enhance user experience and learning outcomes. While Shackel (1986) advocated that usability is about minimizing system complexity to improve learnability, Abran et al. (2004) showed that reducing complexity and improving navigation consistency are recognized usability quality factors. Another study by Abuhlfaia and de Quincey (2020) concluded that enhancing navigation and ensuring interface consistency were critical in improving system usability. This aligns closely with the feedback from participants in the present study, where similar concerns were among the most frequently reported issues.

Table 2: Average Converted Response from All Users for each SUS Item

SN	System Usability Scale Item	Average
1	I would like to use this system frequently	3.0
2	I found the system unnecessarily complex	2.4
3	The system was easy to use	3.1
4	I would need the support of a technical person to be able to use this system	3.0
5	I found the various functions in this system were well integrated	2.5
6	There was too much inconsistency in this system	3.2
7	I would imagine that most people would learn to use this system very quickly	3.1
8	I found the system very cumbersome to use	2.8
9	I felt very confident using the system	2.9
10	I needed to learn a lot of things before I could get going with this system	2.9

Addressing the complexity and integration issues by simplifying workflows and enhancing interface clarity would further strengthen the Dinari lab in consistency with usability research in educational technologies. Molina et al. (2022), in their systematic review of usability studies, emphasized that learnability, consistency and interface clarity are among the most critical factors influencing user experience in learning environments. Their findings confirm that when systems reduce complexity and support users with clear and intuitive navigation, learners are more likely to adopt the technology and engage meaningfully with its functions.

Conclusions and Recommendations

The study shows that the Dinari blockchain lab achieved a usability score above the accepted benchmark. Therefore, Dinari blockchain lab is a usable and effective platform within the Tanzanian context. While overall usability was acceptable, certain aspects, such as navigation, workflow clarity and user support remain important areas for enhancement.

Based on the conclusions, the study recommends that blockchain learning strategies be integrated into academic programs and innovation hubs in Tanzania. This will help maximize its impact on blockchain literacy, research capacity and innovation activities. Future developments should focus on refining navigation, simplifying workflows and providing user support tools, such as tutorials or in-app guidance.

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