# Enhancing Social Experience in Home Network Assisted Tools

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## ABSTRACT

The quality of social interaction within modern households is increasingly shaped by digital connectivity. However, many existing home network management tools remain technically complex and insufficiently user-centered, limiting their effectiveness in supporting safe and balanced digital engagement. Grounded in usability theory, this study evaluates how a mobile-based Home Network Assisted Tool enhances social experience through improved usability and parental control features. The evaluation framework integrates functional system testing, demographic-based usability assessment, and System Usability Scale (SUS) analysis. Descriptive statistical analysis (mean = 85.5, SD = 6.12) indicates excellent usability performance, supported by a 95% confidence interval within the Grade A range. Additionally, social experience indicators reveal increased parental confidence and reduced supervision stress. Findings demonstrate that usability-centered design in home networking technologies contributes not only to technical efficiency but also to measurable improvements in household digital well-being.

**Keywords:** Home network, network management, usability theory, social experience, system usability scale (SUS), parental control.

## INTRODUCTION

Digital technologies have redefined the structure of everyday social interaction, particularly within households where home internet connectivity serves as the backbone of communication, entertainment, and learning. From a Human–Computer Interaction (HCI) perspective, the usability of supporting technologies strongly determines whether digital tools facilitate or hinder social engagement [1]. When systems are difficult to understand or operate, user frustration increases, which subsequently reduces adoption and limits meaningful interaction.

In the context of home networking, many existing Home Network Assisted Tools (HNATs) present significant usability challenges. Research on interaction within home networking environments also emphasizes the importance of embedding usability into digital infrastructure to support everyday household coordination [2]. Although these tools aim to provide monitoring, control, and security features, they are often designed with technical users in mind, resulting in complex interfaces, networking terminology, and multi-step configuration processes. Such designs contradict established usability principles that emphasize learnability, simplicity, and reduced cognitive load [3]. Similar usability limitations have also been reported in comparative evaluations of existing home network management tools, where technical complexity was found to hinder effective use by non-expert household users [4]. Furthermore, many HNATs are desktop-dependent, restricting timely access and limiting real-time supervision. This creates a gap between system capability and user ability, where powerful features exist but remain underutilized due to poor usability design.

These usability shortcomings have broader social implications within households. Parents, who play a central role in supervising children's digital activities, may feel overwhelmed by complicated network tools. This can lead to reduced parental involvement in managing online behavior, increased exposure to unsafe content, and tension surrounding screen-time control. According to usability theory, when a system demands excessive

mental effort, users are more likely to abandon it or use it incorrectly, which undermines its intended benefits [5]. Therefore, the issue is not merely technical inefficiency but a barrier to healthy digital social interaction within families.

Usability Theory provides a structured solution to these problems by guiding the design of systems that are effective, efficient, and satisfying to use [1]. Effective systems allow users to achieve goals accurately; efficient systems minimize the effort required; and satisfying systems create positive user experiences that encourage continued use. By applying these principles to home network tools, interfaces can be simplified, feedback can be made clearer, and tasks such as monitoring, filtering, and scheduling can become intuitive rather than burdensome. Research in HCI consistently shows that improving perceived ease of use significantly enhances user confidence, technology adoption, and sustained engagement [6].

This study investigates the usability of a mobile-based Home Network Assisted Tool and its contribution to enhancing digital social experience. Drawing upon ISO 9241-11 usability standards, the research examines how improvements in effectiveness, efficiency, and satisfaction reduce cognitive burden, empower parents to manage household internet use confidently, and ultimately foster a safer and more positive digital environment within families.

## Theoretical Foundation

### A. Usability Theory

Usability theory posits that systems should enable users to achieve their goals effectively, efficiently, and satisfactorily [5]. Nielsen further expands usability into learnability, efficiency of use, memorability, error reduction, and satisfaction [1]. These dimensions collectively ensure that technology serves human needs rather than creating barriers. Beyond the core usability dimensions illustrated in Fig. 1, user experience design research highlights that users' emotional responses toward technology also influence long-term engagement and perceived value [7].

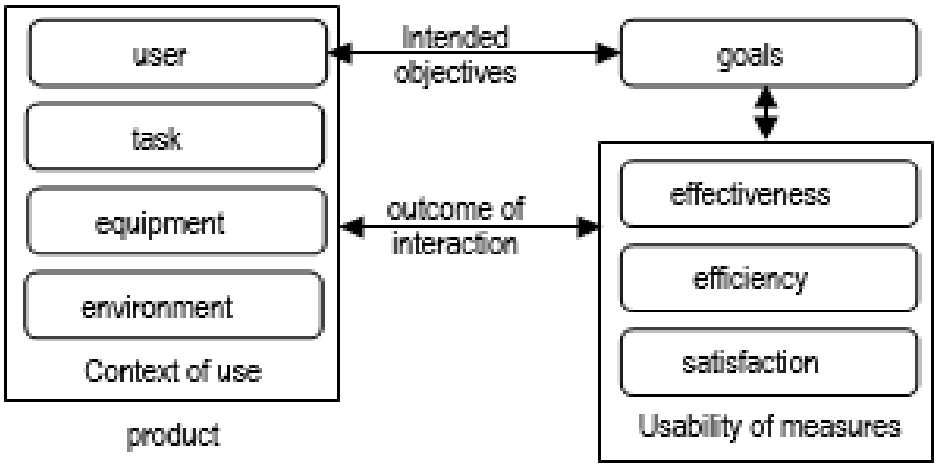


Fig. 1 Core Usability Dimensions in Human–Computer Interaction

### B. Usability in Domestic Digital Environments

Within households, usability directly shapes how confidently parents can manage internet use and how safely children engage with online environments. Systems that are difficult to use increase cognitive burden and discourage active supervision [1]. Extensions of cognitive load theory further explain how minimizing extraneous mental processing improves task performance and interaction efficiency [8]. Conversely, user-friendly systems encourage engagement and shared digital responsibility, improving the quality of digital social interaction.

This perspective is consistent with interaction design principles, which emphasize aligning system structure

with users' mental models and everyday tasks rather than technical system architecture [9]. This aligns with research suggesting that perceived ease of use strongly influences technology acceptance and sustained use [6].

## C. Conceptual Framework

The study proposes that usability acts as a mediator between technology and social experience. When a system demonstrates high effectiveness, efficiency, and satisfaction, users feel empowered, which leads to improved digital supervision, reduced stress, and more positive household interaction.

**Problem Statement**

Despite the increasing availability of Home Network Assisted Tools (HNATs), many households still struggle to effectively manage their home internet environments. From a usability standpoint, the core issue lies not in the lack of technical features, but in the mismatch between system design and user capability. Many existing tools are developed with networking professionals in mind, resulting in interfaces filled with technical terminology, complex configuration menus, and multi-layer navigation structures. Such designs violate fundamental usability principles, particularly those related to learnability and cognitive simplicity [1].

One major problem is the high cognitive load required to operate these systems. Cognitive load theory in HCI suggests that when users must expend excessive mental effort to understand a system, performance decreases and error rates increase [10][1]. In home environments, parents often need to perform tasks such as checking connected devices, restricting access, or scheduling internet usage quickly and intuitively. However, when these actions involve complicated procedures, users are more likely to avoid using the system altogether. This results in underutilization of important safety features, reducing the effectiveness of the technology.

Another critical issue is limited accessibility. Many HNATs are web-based and require users to log in through desktop or laptop computers. This restricts real-time control and contradicts the principle of contextual usability, which emphasizes that systems should be usable in the environments where tasks naturally occur [5]. Since internet supervision often happens spontaneously, such as when a child is using a device in the living room, desktop-bound systems create delays that weaken parental control. Accordingly, Fig. 2 presents the structured usability-based solution framework designed to systematically identify, evaluate, and correct usability problems in Home Network Assisted Tools.

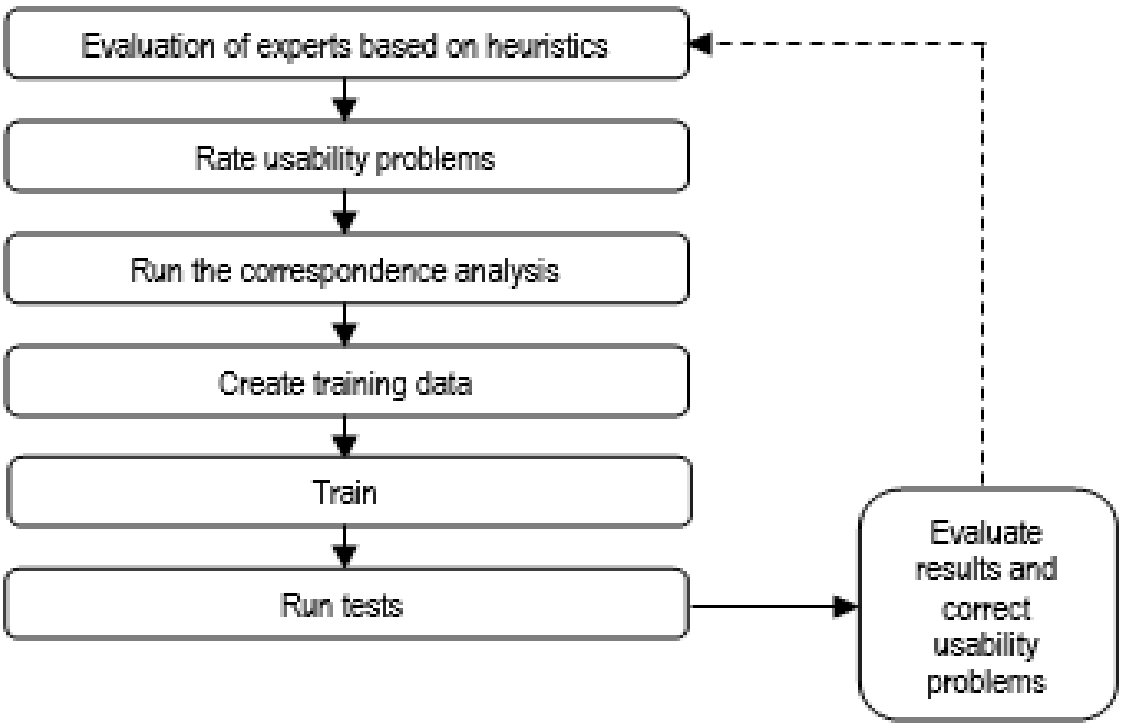


Fig. 2 Problems and Usability-Based Solutions in Home Network Assisted Tools

These usability shortcomings have direct consequences on the social experience within households. When parents feel uncertain or incapable of managing digital activity, it can lead to increased stress, conflicts over screen time, and reduced trust in technology.

According to the Technology Acceptance Model, perceived ease of use strongly influences user confidence and willingness to adopt a system (Davis, 1989). Later extensions such as the Unified Theory of Acceptance and Use of Technology (UTAUT) further confirm that perceived ease of use significantly influences behavioral intention to adopt technology [11]. Therefore, poor usability in HNATs does not only affect technical performance but also undermines family digital well-being.

To address these challenges, usability theory provides a structured framework for designing systems that align with human capabilities. By focusing on effectiveness, efficiency, and satisfaction, usability-centered design can transform HNATs into intuitive tools that empower parents rather than overwhelm them.

Simplified interfaces, clear system feedback, and mobile accessibility can significantly reduce cognitive burden and encourage active engagement in managing home networks. In turn, this enhances digital safety, promotes balanced internet use, and supports healthier social interaction within families.

The identified Home Network Assisted Tools (HNATs) problems can be systematically addressed using principles from usability theory, linking technical improvements with measurable social outcomes within households.

The first issue, complex interfaces, is linked to the usability principles of learnability and simplicity [1]. When interfaces are intuitive and easy to understand, parents can operate network management tools with greater confidence, reducing hesitation and increasing active supervision of household internet usage.

The second issue involves high cognitive load, where users must exert excessive mental effort to perform basic tasks. According to cognitive load theory, reducing unnecessary complexity enables users to process information more efficiently [10]. In the context of home networking, simplified workflows and clear visual feedback reduce parental stress during monitoring and control activities, supporting a calmer and more manageable digital environment.

Desktop dependency represents a limitation in contextual usability. ISO 9241-11 emphasizes that systems should support users within their actual context of use [5]. By enabling mobile-based access, HNATs become available whenever and wherever supervision is needed, allowing faster response to emerging situations such as excessive screen time or access to inappropriate content.

Finally, low user confidence is addressed through the concept of perceived ease of use from the Technology Acceptance Model [6]. When systems feel easy to operate, users are more likely to adopt them consistently and trust their functionality.

This increased trust encourages regular parental involvement in digital supervision, ultimately fostering healthier and more positive digital social interaction within the household. The structured mapping of these problems, corresponding usability principles, and expected social impacts is presented in TABLE I.

**TABLE I Problems Found in Home NETWORK-ASSISTED Tools**

| HNAT Problem | Usability Theory Principle | Expected Social Impact |
|---|---|---|
| Complex interfaces | Learnability & Simplicity (Nielsen, 2012) | Parents use tools confidently |
| High cognitive load | Cognitive Load Reduction (Sweller, 1988) | Less stress in supervision |
| Desktop dependency | Context of Use (ISO 9241-11) | Faster real-time response |
| Low user confidence | Perceived Ease of Use (Davis, 1989) | Higher adoption & trust |

# METHODOLOGY

### Testing Framework Based on the Usability Theory

This study adopts a usability-driven testing framework to evaluate how a Home Network Assisted Tool (HNAT) can enhance social experience within households. Rather than focusing solely on technical performance, the methodology is grounded in usability theory, which emphasizes that system quality must be assessed through both functional reliability and user-centered interaction outcomes [5][1].

Usability theory identifies three primary dimensions of effective system interaction: effectiveness, efficiency, and satisfaction. These dimensions formed the foundation of the testing framework used in this study. The evaluation process was therefore divided into two complementary stages: functional testing and usability testing. Functional testing ensures that system features operate correctly and support goal completion (effectiveness), while usability testing measures how easily and comfortably users can perform those tasks (efficiency and satisfaction) [12][13].

### A. Functional Testing Framework

Functional testing was conducted to verify that the HNAT system performed its intended operations without error. From a usability perspective, functional reliability is a prerequisite for effectiveness, as users cannot achieve their goals if system features fail or behave unpredictably [1]. Testing focused on core modules that directly influence parental control and digital supervision includes device monitoring, website filtering, device disconnection and automated time-based scheduling.

Each module was tested in a real home Wi-Fi environment using an Android mobile device. Successful execution of these features ensured that users could accomplish supervision tasks accurately and completely, fulfilling the effectiveness component of usability theory.

### B. Usability Testing Framework

To evaluate efficiency and satisfaction, the study employed the System Usability Scale (SUS), a standardized and widely validated usability assessment instrument [14]. SUS is particularly suitable for small-sample usability studies and provides reliable measurements of perceived system usability across various domains [13].

Participants interacted with the HNAT system before completing the SUS questionnaire, which consists of 10 statements rated on a 5-point Likert scale. The instrument captures user perceptions related to ease of use, confidence, complexity, and overall satisfaction, all of which align with usability theory dimensions. Fig. 3 presents the SUS evaluation model used in this study, including score interpretation ranges and qualitative usability classifications.

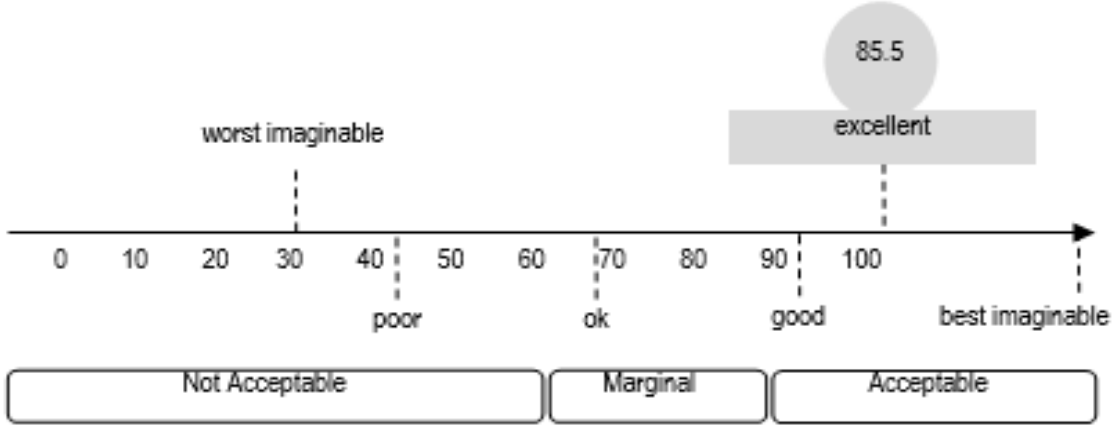


Fig. 3 SUS Evaluation Model within the Usability Testing Framework

**Functional Testing and Usability Implications**

To evaluate efficiency and satisfaction, the study employed Functional testing verifies whether system features operate correctly, but from a usability perspective, it also confirms whether users can rely on the system to achieve their intended goals without unexpected errors [1].

**Device Monitoring**

The application accurately identified connected devices. Usability theory suggests that clear visibility of system status enhances user trust and reduces uncertainty [3][15].

**Website Filtering**

Filtering functions operated effectively. This supports goal-directed interaction, where parents can successfully implement protective measures with minimal effort [5].

**Device Disconnection**

Immediate device removal was achieved [3]. According to usability principles, direct manipulation and immediate feedback enhance perceived control and satisfaction [16].

**Time Scheduling**

Automatic disconnection at scheduled times worked reliably. Efficiency in task automation reduces cognitive load and supports sustainable digital habits [1].

A summary of the testing outcomes and associated usability implications is presented in TABLE II.

**TABLE II Functional Testing Outcomes and Usability Interpretation**

| Feature | Technical Result | Usability Dimension Supported |
|---|---|---|
| Device Monitoring | Successful | Effectiveness |
| Website Filtering | Successful | Satisfaction |
| Device Disconnection | Successful | Efficiency |
| Time Scheduling | Successful | Efficiency & Satisfaction |

**Usability Testing Results (Sus Evaluation)**

While functional testing verifies that system features operate as intended, usability testing provides empirical evidence regarding how users perceive the system's ease of use, learnability, and overall interaction quality. According to usability theory, a technically reliable system may still fail if users experience difficulty or discomfort during interaction [1]. Therefore, this study employed the System Usability Scale (SUS) to quantitatively evaluate perceived usability based on the dimensions of effectiveness, efficiency, and satisfaction outlined in [5].

**SUS Evaluation Framework**

The System Usability Scale is a standardized usability instrument consisting of ten statements rated on a five-point Likert scale ranging from Strongly Disagree to Strongly Agree [14]. SUS is widely recognized for its reliability and validity across various domains, including mobile applications and consumer technologies. The robustness of SUS across different domains and system types has been extensively discussed in usability research, reinforcing its validity as a global usability metric [17].

It provides a global usability score that reflects how users perceive system complexity, ease of use, confidence, and integration of features [13]. The structure of the ten SUS items used in this study is shown on Fig. 4.

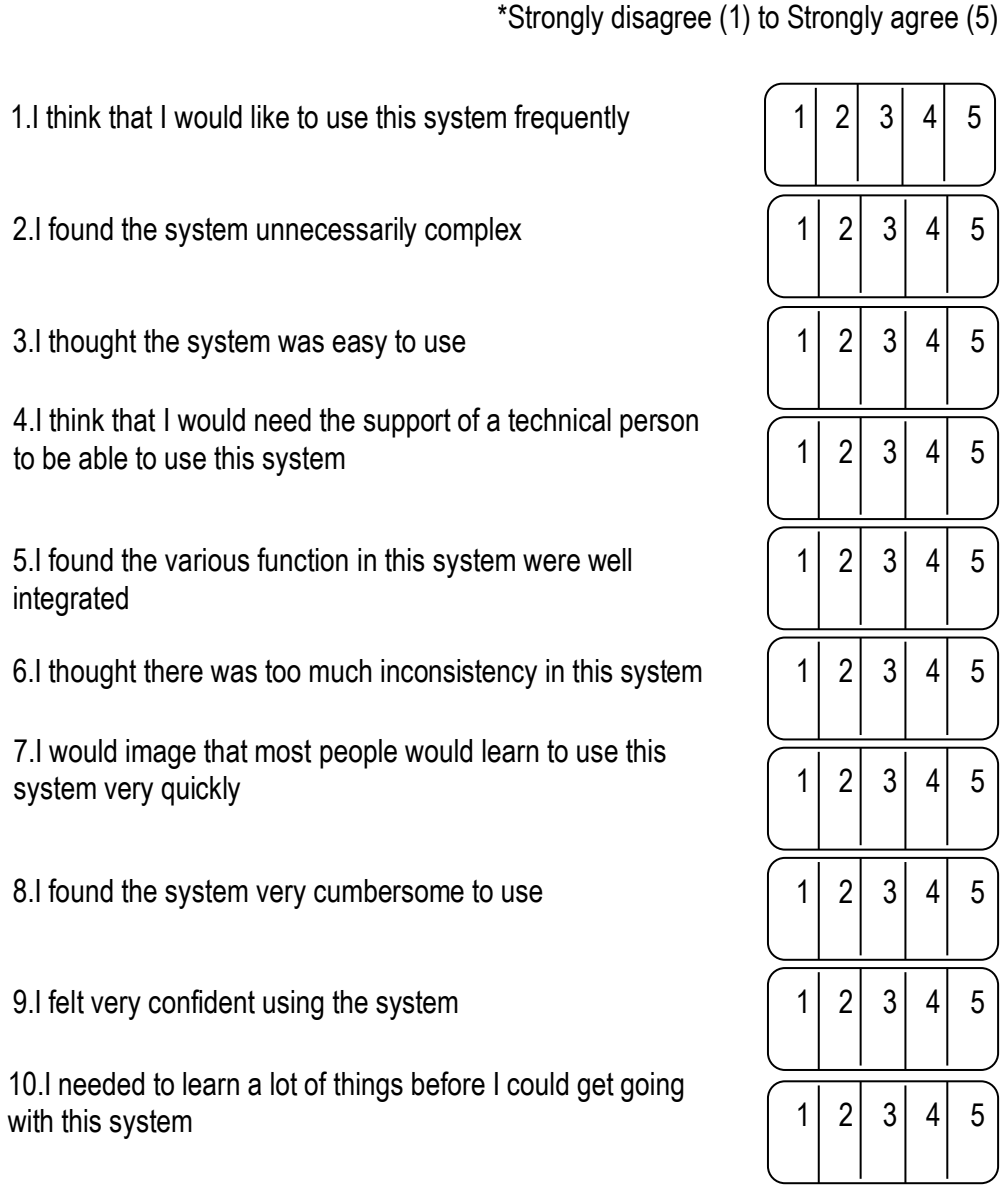


Fig. 4 SUS Evaluation Model within the Usability Testing Process

**B. Participants and Procedure**

A total of 10 participants were involved in the usability evaluation. Although the sample size is modest, usability research has consistently demonstrated that small participant groups are sufficient to reveal major usability trends and interaction patterns [1].

The demographic background of participants is summarized in TABLE III to provide contextual clarity and improve interpretability of usability findings. Participants engaged with the system in realistic home-network scenarios, including viewing connected devices, applying website filters, disconnecting devices, and scheduling internet access times.

**TABLE III** PARTICIPANT DEMOGRAPHIC PROFILE

| Variable | Category | Frequency |
|---|---|---|
| Age Range | 20-34 | 4 |

| | | |
|---|---|---|
| | 35-44<br>45-50 | 5<br>1 |
| Status | Parent<br>Non-parent | 8<br>2 |
| Technical Background | IT-related<br>Non-IT | 3<br>7 |
| Household Types | Family with children<br>Shared residence | 8<br>2 |

The majority of participants were parents actively managing home internet environments. Most participants did not possess formal technical backgrounds, making the usability evaluation particularly relevant to non-expert household users. This demographic composition strengthens the ecological validity of the findings.

Following the interaction session, participants completed the SUS questionnaire. Individual responses were converted into SUS scores using the standard scoring formula, resulting in a value between 0 and 100 [14].

**C. SUS Score Results**

The calculated SUS score placed the system within the 78.9–100 range, corresponding to Grade A (Excellent usability) according to established SUS grading scales. The SUS grading scale applied in this study is shown in TABLE IV.

**TABLE IV** SUS Score Interpretation

| SUS Score Range | Grade | Usability Level |
|---|---|---|
| 78.9 – 100 | A | Excellent |
| 72.6 – 78.8 | B | Good |
| 62.7 – 72.5 | C | Acceptable |
| Below 62.7 | D – F | Poor to Awful |

In addition to the overall SUS classification, descriptive statistics were computed to enhance transparency of reporting (refer TABLE V). The relatively low standard deviation indicates consistent agreement among participants regarding system usability. The 95% confidence interval further suggests that the system's true usability performance is highly likely to remain within the Grade A classification range.

**TABLE V** DESCRIPTIVE STATISTICS OF SUS SCORES

| Statistic | Value |
|---|---|
| Sample Size (n) | 10 |
| Mean SUS Score | 85.5 |

| | |
|---|---|
| Standard Deviation | 6.12 |
| Minimum Score | 76 |
| Maximum Score | 94 |
| 95% Confidence Interval | 81.2 – 89.8 |

**D. Statistical Interpretation**

From a statistical perspective, the system's SUS score is well above the commonly cited average usability benchmark of 68 [13]. This indicates a strong positive deviation from baseline usability expectations. Systems scoring within the Grade A range are typically associated with top-tier usability performance, often ranking within the upper usability percentile of evaluated products [18].

The inclusion of standard deviation and confidence interval further strengthens the statistical transparency of the usability findings. Furthermore, SUS remains statistically reliable even with limited participants because usability perceptions tend to converge across users [1]. High SUS scores statistically imply consistent agreement among participants regarding statements such as ease of use, confidence in system interaction, and minimal need for technical support.

**E. Usability Theory Interpretation**

The high SUS score reflects strong performance across the three primary usability dimensions:

1. Effectiveness: Users were able to complete tasks successfully
2. Efficiency: Tasks required minimal effort and time
3. Satisfaction: Users reported positive interaction experiences

These findings align with Norman's argument that systems designed to match human cognitive processes reduce mental workload and increase perceived control [3]. In home network contexts, this translates into greater parental confidence in supervising digital activities.

Furthermore, the strong perceived ease of use supports the Technology Acceptance Model, which states that ease of use is a key predictor of user trust and continued system adoption [6]. Therefore, the statistical usability results provide evidence that the system is not only technically functional but also socially supportive by encouraging active parental involvement in managing household internet usage.

**F. Social Experience Indicator Assessment**

To bridge the conceptual gap between usability outcomes and social experience claims, participants were asked to rate perceived changes in digital supervision confidence and household interaction quality after system use (refer TABLE VI).

**TABLE VI** Perceived Social Experience Impact

| Indicator | Mean (1 – 5) |
|---|---|
| Increased parental confidence | 4.6 |
| Reduced supervision stress | 4.4 |
| Improved control over screen time | 4.5 |
| Improved family digital harmony | 4.3 |

These findings suggest that usability improvements are directly associated with perceived improvements in digital supervision confidence and household interaction stability, supporting the conceptual mediation framework proposed in Section II.

## DISCUSSION

This study aimed to evaluate how usability-centered design in a Home Network Assisted Tool (HNAT) contributes to enhancing digital social experience within households. The findings from both functional testing and SUS-based usability evaluation indicate that the system performs strongly not only in technical reliability but also in perceived user interaction quality.

From a usability theory perspective, the functional testing results confirm that the system satisfies the effective dimension of ISO 9241-11, as users were able to successfully complete core supervision tasks such as device monitoring, website filtering, device disconnection, and time scheduling. Reliable feature performance ensures that users can achieve intended goals without unexpected system failures, which is a foundational requirement for positive user experience [1].

The SUS usability evaluation further strengthens these findings. The system achieved a SUS score within the Grade A (Excellent) range, indicating very high perceived usability. Statistically, this places the system well above the widely accepted industry benchmark score of 68, suggesting that users found the system significantly easier to use than an average application [13]. High SUS performance is typically associated with lower perceived complexity, higher confidence, and reduced need for external assistance — all of which are central indicators of efficiency and satisfaction in usability theory.

Importantly, these findings are consistent with the results reported in the evaluation of the Home Network Assisted Tools simulation, where a SUS score of 88.75/100 was obtained [19]. That earlier study also placed the system within the Grade A usability category, corresponding to the upper usability percentile based on Sauro's SUS grading scale. The similarity between the present findings and the previous student evaluation suggests a stable and repeatable usability outcome, indicating that the system's high usability is not incidental but reflects a consistent design strength.

This consistency is particularly important from a statistical and HCI standpoint. When separate groups of users report similarly high SUS scores, it implies that usability perceptions are not highly variable across users, which strengthens the reliability of the usability claim. In usability research, such convergence of results supports the argument that the interface design successfully aligns with human cognitive processes, reducing mental workload and interaction friction [3].

Beyond technical and perceptual measures, the discussion must also consider the broader social implications. Usability theory suggests that systems requiring less cognitive effort encourage more frequent and confident use. In domestic environments, this translates into parents being more willing to engage in digital supervision activities such as monitoring connected devices and managing screen time. Increased ease of use therefore reduces supervision stress and supports more structured, balanced internet usage within the household.

These outcomes align with the Technology Acceptance Model, which identifies perceived ease of use as a major predictor of technology adoption and sustained usage [6]. The high SUS scores observed in both the present and previous studies indicate that users are likely to trust and continuously use the system. In practical terms, this means that usability improvements contribute directly to enhanced digital social experience, where technology supports rather than disrupts family interaction and digital well-being.

In summary, the discussion highlights three key points:

1. Functional reliability supports effectiveness in usability theory
2. High SUS scores statistically confirm strong efficiency and satisfaction
3. Consistent results across different user groups reinforce usability reliability

Together, these findings demonstrate that improving usability is not merely an interface enhancement but a socially meaningful intervention that empowers families to manage digital environments more confidently and harmoniously.

This study extends existing research in three significant ways:

1. It integrates ISO 9241-11 usability dimensions with measurable domestic social indicators.
2. It demonstrates statistical consistency of SUS performance across independent user groups.
3. It empirically links usability-centered design with perceived improvements in parental supervision confidence.

Unlike previous studies that focus primarily on technical functionality or interface evaluation, this research positions usability as a mediating factor between digital infrastructure and social well-being.

## CONCLUSION

This study examined how usability-centered design in a Home Network Assisted Tool (HNAT) can enhance digital social experience within domestic environments. Grounded in usability theory, the research emphasized that system success should be evaluated not only through technical functionality but also through user-centered interaction quality, particularly in terms of effectiveness, efficiency, and satisfaction [5][1].

Functional testing demonstrated that the system supports key parental supervision tasks, including device monitoring, website filtering, device disconnection, and automated time scheduling. These findings confirm that the system meets the effective dimension of usability, enabling users to accomplish their goals accurately and consistently. Reliable system performance is essential in domestic digital environments where parents require dependable tools to manage household internet usage.

The usability evaluation using the System Usability Scale (SUS) further provided quantitative evidence of strong perceived usability. The system achieved a SUS score within the Grade A (Excellent) range, placing it well above the industry average usability benchmark. This indicates that users perceived the system as easy to use, well-integrated, and confidence inspiring. Statistical interpretation of SUS results suggests that such high scores are typically associated with reduced cognitive load, lower interaction errors, and higher user satisfaction [13][3].

Importantly, the present findings aligned with previous usability testing conducted on the Home Network Assisted Tools, which reported a SUS score of 88.75/100. The consistency between studies reinforces the reliability of the usability outcomes and supports the argument that the system's design effectively adheres to usability principles. This convergence of results strengthens the claim that usability improvements are both measurable and repeatable across different user groups.

From a broader perspective, the study highlights that usability plays a crucial role in shaping digital social experience within households. Systems that are easy to use encourage more active parental involvement in supervising digital activities, reduce stress associated with network management, and promote healthier and more balanced internet usage patterns. These findings support the Technology Acceptance Model, which emphasizes perceived ease of use as a key determinant of sustained technology adoption [6].

In conclusion, the study demonstrates that enhancing usability in home network management tools is not merely a technical refinement but a socially impactful design strategy. By aligning system design with human cognitive capabilities, usability-centered approaches empower families to engage more confidently in digital life. Future research may incorporate larger samples, longitudinal studies, and additional usability metrics to further examine the relationship between system usability and long-term digital well-being.

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