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Application and Effectiveness of User Research in Optimizing Interactive Design

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Abstract: With the increasing richness of various digital products and services in the information age, the importance of user experience research in the field of interface design continues to rise. By exploring users' specific needs, usage habits, and feedback information, designers can create design solutions that better meet users' expectations. This article deeply analyzes the practical application of user experience research in the process of interface design improvement, and provides a detailed interpretation of its impact in the early stages of design, usability evaluation, and decision-making. In addition, the article also explores the design achievements and challenges encountered in user experience research, providing valuable references for future design work.

1. Introduction

In the field of interaction design, the core pursuit is to optimize the user's interactive experience, and user research, as the cornerstone of this pursuit, has irreplaceable importance. By exploring users' actual needs, behavior patterns, and their feedback, designers can make more accurate choices throughout the entire product design process. This article aims to delve into the application of user research in the implementation process of interaction design and its resulting effects, while analyzing the challenges faced, contributing theoretical basis and operational suggestions for further optimization and progress in the field of interaction design.

2. The relationship between user research and interaction design

There is a close correlation between user exploration and interaction planning. The core purpose of interaction design is to enhance the user experience, ensure the convenience and efficiency of products and services. User research is an important way to understand user needs, behavior patterns, and emotional responses. Through user research, designers can gain insights into the specific characteristics, intrinsic driving forces, usage habits, as well as the difficulties and discomforts encountered by target users when operating products. This provides empirical and theoretical support for interactive planning.

Interaction design is not only about a beautiful interface and smooth operation process, but also requires the design to effectively solve users' specific problems and achieve their expected goals.

User research utilizes quantitative and qualitative methods to assist designers in making precise design revisions from the user's perspective. For example, by conducting individual interviews, filling out questionnaires, and conducting usability assessments, researchers can collect key data on users' emotional feedback, operational barriers, and evolving needs during product use. These data have great reference value for design decisions, helping designs to be more closely aligned with users' actual needs.

Therefore, user research is not only a crucial step in the initiation phase of interaction design, but also an indispensable feedback loop throughout the entire design process. The effectiveness of interaction design largely depends on the accurate insights provided by user research. Designers can continuously improve products by closely integrating user research with various stages of interaction design, ensuring that the final design results meet established user experience standards.

3. Application of User Research in Interaction Design

3.1 The role of user research in the initial design phase

In the initial stage of interaction design, conducting user research is crucial to ensure the correctness of design ideas and their alignment with user needs. The research process allows designers to collect various information about users, including basic information, behavioral patterns, specific needs, emotional feedback, and application scenarios. These valuable pieces of information will guide designers in building appropriate design structures and determining the implementation sequence of functions, preventing deviations between design solutions and actual user needs.

When conducting user research, designers can obtain quantitative data information through questionnaire surveys. Set a question about user usage frequency, assuming n user participates in a survey and the question is "How many times have you used this product in the past week. The user's answer can be an integer representing the number of times each user has used it. By calculating the average usage frequency of all users, the overall usage frequency is obtained:

$$\overline{X} = \frac{1}{n}\sum_{i=1}^{n} X_i \tag{1}$$

Among them, X_i represents the usage frequency of the i user, and $\overline{X}$ is the average usage frequency of all users.

Through this method, designers can obtain objective data about product usage and adjust their design plans accordingly.

3.2 Usability testing and prototype design optimization

In user experience research, usability testing in the interaction design phase plays an indispensable role, especially in the process of developing prototypes. Designers invite target audiences to perform actual operations on the prototype, monitor their every move, collect feedback information after use, and evaluate the humanization level of the design.

Among various evaluation criteria, Task Completion Rate (TCR) is a commonly used indicator to measure design effectiveness, which reveals the efficiency of users in completing predetermined tasks. Assuming that there are n users participating in the testing process, and k of them successfully complete the specified task, the task completion rate can be calculated as:

$$TCR = \frac{k}{n} \times 100\% \tag{2}$$

For example, if 20 users participate in the test and 18 of them successfully complete the task, then the task completion rate is:

$$TCR = \frac{18}{20} \times 100\% = 90\% \tag{3}$$

By examining the task completion rate, designers can infer the user experience of prototype design and optimize the interaction process accordingly. If the task completion rate is not satisfactory, designers need to delve into the user's behavior trajectory in order to discover and eliminate obstacles in the interaction process.

3.3 Integration of User Feedback and Design Decisions

Collecting user feedback plays an indispensable role in the process of interaction design. Designers can obtain user feedback through various channels, such as online surveys, face-to-face interviews, social media platforms, and more. The feedback from users is an important basis for designers to evaluate whether design elements meet the actual needs of users and determine which parts or designs need further adjustments.

When collecting user satisfaction, the Satisfaction Index (SI) is commonly used to measure the user acceptance of design solutions.Assuming that n users have rated the design, and each user's rating is S_i (ranging from 1 to 5), the satisfaction index SI can be expressed as:

$$SI = \frac{1}{n} \sum_{i=1}^{n} S_i \tag{4}$$

For example, if 10 users participate in rating, with ratings of 5, 4, 3, 4, 5, 5, 3, 4, 4, 5, the satisfaction index would be:

$$SI = \frac{1}{10}(5+4+3+4+5+5+3+4+4+5) = \frac{44}{10} = 4.4 \tag{5}$$

A satisfaction index close to 5 indicates that users are very satisfied with the design scheme, while a lower index indicates the need for improvement. Designers adjust products based on user feedback to improve user experience.

3.4 Data driven design decisions

Data based design decisions have become a widely adopted strategy in the field of contemporary interactive design, with the core of mining key intelligence from user behavior data to guide continuous design improvement. By collecting and analyzing user behavior data in depth, designers can clearly grasp the details of user product interaction and make precise design revisions accordingly.

For example, designers can use A/B testing to compare the effectiveness of two design options. In A/B testing, users are randomly assigned to two groups to experience Plan A and Plan B respectively. Assuming that the average time for users in Plan A to complete tasks is Y_A, and the average time for users in Plan B to complete tasks is T_B, it is possible to determine which design is

more efficient by comparing the average completion times of the two plans. Set the completion time difference ΔT as:

$$\Delta T = T_B - T_A \tag{6}$$

If $\Delta T > 0$, the design efficiency of Plan B is relatively low, and the designer may need to optimize Plan B. On the contrary, it indicates that Plan A has design flaws and needs to be adjusted.

In addition, designers can also determine the effectiveness of page elements based on user click through rate (CTR) data. Assuming a link on a page has m clicks and the total number of page impressions is n, the click through rate can be expressed as:

$$CTB = \frac{m}{n} \times 100\% \tag{7}$$

By analyzing this data, designers can understand which elements are favored by users and which features have not received enough attention, thus optimizing the design.

4. The effectiveness and challenges of user research

4.1 The effect of user research on improving design quality

The importance of user research is evident in enhancing the quality of interaction design. By collecting feedback and data from actual users, designers are able to evaluate products from their perspective, identify and address design deficiencies, and improve functionality, interface, and interactive processes to enhance the overall level of design. User research brings valuable first-hand information to designers, ensuring that design solutions are more closely aligned with users' actual expectations and needs.

Table 1. Impact of User Research on Design Quality Improvement

Design field	The specific role of user research	Design quality improvement
functional design	Understand user needs through user research to avoid excessive or missing features	Ensure that the designed functions meet the real needs of users, avoid functional redundancy and unnecessary complexity
Interface Design	User feedback helps optimize interface layout and visual design	Enhance the usability and aesthetics of the interface, and improve user operation efficiency
Interaction Design	Usability testing reveals pain points in the interaction process, improves button placement, operation paths, etc	Optimize user operation paths and interaction efficiency, reduce user operation costs, and improve user satisfaction
User experience	Continuously optimize product design by integrating user feedback, behavior analysis, etc	Improve user satisfaction, loyalty, and reputation, and enhance the market competitiveness of products

In addition, user research also helps designers gain a deeper understanding of users' needs and make refined adjustments to various aspects of the design. With a profound understanding of user behavior, emotional response, and actual usage scenarios, designers can comprehensively enhance the usability, usability, and user experience of products. The following will elaborate on the application of user research in multiple design fields and its role in promoting design quality.

In the functional design phase, in-depth user research can guide designers to accurately identify

users' core needs, screen out key functions, and eliminate redundant complex functions to prevent the loss of key functions. Taking a sports and health application as an example, user research has shown that users value exercise data tracking and health analysis functions the most. Based on this, designers have placed these two functions in the most prominent position on the interface, greatly optimizing the user's interactive experience.

As for interface layout design, direct feedback from users is crucial for designers to grasp the intuitive user experience. For example, user research may reveal that certain button colors are too close to the background, making it easy for users to accidentally touch them during operation. Based on these feedbacks, the designer adjusted the color and size of the buttons, thereby improving the convenience of user operation. In summary, by delving into user needs and habits, user research provides customized improvement solutions for every aspect of interaction design, effectively promoting the improvement of design quality.

4.2 Actual Results of Design Optimization

In depth analysis of user behavior not only significantly improves the quality of interaction design, but also directly reflects in the specific results generated. Design optimization is a continuous activity that relies on continuous evaluation of user feedback and corresponding adjustments in design. This improvement process often relies on various data and evaluation indicators to quantify and form visible design outputs.

In specific implementation, the improvement effect of product design is significantly reflected in key indicators such as enhancing user satisfaction, increasing feature utilization, and reducing user churn rate. The carefully improved design product has achieved a better balance in functional implementation, smooth operation, and visual presentation, thus receiving positive feedback from a wider user base. For example, in the process of improving the interface design of a shopping platform, the design team conducted research on users' usage habits and found that during the product browsing process, users often feel confused due to the complexity of information. Designers have optimized the structure and improved the presentation of information on the product display page, making it more concise. According to data feedback, the conversion rate of the page has increased by 20%, and the average duration of user page stay has also been extended by 15%. This improvement case effectively demonstrates the core role of user research in the interaction design process.

4.3 Challenges and limitations faced by user research

Although user experience research can greatly improve the effectiveness and quality of interaction design, it inevitably encounters many difficulties and constraints in the specific execution stage. These challenges and constraints are often reflected in the complexity of data collection, the adaptability of research methods, limited time and resources, and the level of user engagement.

In many cases, user research faces the common problem of data bias. For example, in the process of selecting samples, if the study only targets a specific circle, it may overlook the diverse needs and behavioral patterns of the target user group, which will have a negative impact on the accuracy of the research results. Meanwhile, the inherent subjective cognitive biases of participants may also cause feedback information to lose its neutrality, thereby interfering with the rationality of design decisions.

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Table 2. Challenges and limitations faced by user research

Challenge/Limitations	describe	influence
Data bias	User feedback and research data may be limited by sample selection bias or users' own cognitive biases	Causing research results to be unrepresentative and affecting the accuracy of design decisions
Resource limitations	Conducting large-scale user research requires significant time, effort, and financial investment, and may not be fully feasible due to project budget constraints	Limitations on the breadth and depth of research may prevent a comprehensive understanding of user needs and affect design effectiveness
User engagement	The willingness and enthusiasm of users to participate in research are often limited, which may lead to incomplete sample data or insufficient feedback	Insufficient representativeness of research results, which in turn affects the direction of design optimization
Difficulty in connecting design and research	There may be differences in communication between designers and researchers, making it difficult to directly translate research results into feasible design solutions	Reduced the actual contribution of user research to design optimization, resulting in a decrease in the matching degree between design and user needs

In the field of user research, resource limitations often become a key factor restricting its breadth and depth. Extensive and in-depth user research typically requires a significant amount of time and economic investment, especially with limited budgets. The scope and sample size of the research are inevitably compressed, which may affect the accuracy of the research results. Meanwhile, users' enthusiasm for participation is also a major test in the research. If users lack interest and participation in the research, it may lead to incomplete or low-quality sample data, which will affect the final outcome of the study. In addition, poor communication between the design team and researchers is also a common issue. Insufficient communication may make it difficult to effectively translate research results into design improvement measures, weakening the practical application value of user research.

4.4 Dynamic Relationship between User Research and Market Demand

The market situation continues to evolve, and research on users must keep up with market trends to ensure that design solutions are updated in sync with market demand. Technology is advancing rapidly, and user behavior patterns are also changing accordingly. The fluctuations in market demand may be extremely intense, which forces users to have the ability to adapt flexibly in order to assist designers in quickly responding to market changes.

In the fast-growing industries such as mobile Internet and smart devices, the market demand for products changes rapidly, and consumer demand and preferences may fluctuate significantly in a short time. When conducting user research, designers should not only focus on the current needs of users, but also use data mining and trend inference to capture the evolution of future needs as early as possible. This predictive user research is crucial for the long-term development of design. Taking

the smart home industry as an example, with the rapid development of voice assistants and artificial intelligence technology, consumers' demand for controlling household devices has also changed accordingly. Designers need to re-examine and optimize existing designs for the transition from manual control to voice control. In the specific execution process, designers can determine which design elements are most attractive in the current market and which functions may not be favored by consumers by studying market feedback and user behavior data, and then make real-time adjustments to the design.

5. Conclusion

In interactive design, it is crucial for designers to deeply explore user needs, behaviors, and feedback. It can help optimize product performance, user interface, and interactive experience, thereby significantly improving the overall quality of design. Although designers may encounter difficulties such as data errors, uneven resource allocation, and insufficient user engagement in practical user research, these issues may have an impact on the accuracy of research results and the implementation effectiveness of design decisions. Despite these challenges, with the continuous development of technology and innovation in research methods, user research will still play an important role in interaction design. Designers must constantly track market trends and changes in user needs, adjust design strategies in a timely manner to ensure more efficient and accurate design, and help products maintain a leading position in the competitive environment.

Reference:

[1] *Atiah N, Sardjono W. Designing a User Interface Application for a Collection of Recipes Using the Design Thinking Method. Journal of Theoretical and Applied Information Technology, 2023, 101(12):5059-5077.*

[2] *X. Liu, "Research on User Preference Modeling and Dynamic Evolution Based on Multimodal Sequence Data, " 2025 2nd International Conference on Intelligent Algorithms for Computational Intelligence Systems (IACIS), Hassan, India, 2025.*

[3] *J. Huang, "Performance Evaluation Index System and Engineering Best Practice of Production-Level Time Series Machine Learning System, " 2025 International Conference on Intelligent Communication Networks and Computational Techniques (ICICNCT), Bidar, India,*

[4] *A S K, B S P, A T B X, et al. Developing and user-testing a "Digital Twins" prototyping tool for architectural design. Automation in construction, 2022(135-Mar.).*

[5] *Rogers W A, Kadylak T, Bayles M A. Maximizing the Benefits of Participatory Design for Human–Robot Interaction Research with Older Adults: Human Factors: The Journal of Human Factors and Ergonomics Society, 2022, 64(3):441-450.*

[6] *Ahn J, Nguyen H, Lopez J, et al. Reminders, reflections, and relationships: insights from the design of a chatbot for college advising. Information and Learning Sciences, 2023, 124(3/4):128-146.*

[7] *Wang Y, Luo Y. Research on Computer Aided Interaction Design based on Virtual reality Technology. Procedia Computer Science, 2023, 228:619-628.*

[8] *W. Han, "Using Spark Streaming Technology to Drive the Real-Time Construction and Improvement of the Credit Rating System for Financial Customers, " 2025 International Conference on Intelligent Communication Networks and Computational Techniques (ICICNCT), Bidar, India, 2025, pp. 1-6.*

[9] *M. Zhang, "Research on Joint Optimization Algorithm for Image Enhancement and Denoising Based on the Combination of Deep Learning and Variational Models," 2025 International*

Conference on Intelligent Communication Networks and Computational Techniques (ICICNCT), Bidar, India, 2025, pp. 1-5.

[10] Y. Zou, "Research on the Construction and Optimization Algorithm of Cybersecurity Knowledge Graphs Combining Open Information Extraction with Graph Convolutional Networks, " 2025 2nd International Conference on Intelligent Algorithms for Computational Intelligence Systems (IACIS), Hassan, India, 2025, pp. 1-5.

[11] Q. Xu, "Implementation of Intelligent Chatbot Model for Social Media Based on the Combination of Retrieval and Generation," 2025 2nd International Conference on Intelligent Algorithms for Computational Intelligence Systems (IACIS), Hassan, India, 2025, pp. 1-7.

[12] Su H, Luo W, Mehdad Y, et al. Llm-friendly knowledge representation for customer support[C]//Proceedings of the 31st International Conference on Computational Linguistics: Industry Track. 2025: 496-504.

[13] B. Li, "Research on the Spatial Durbin Model Based on Big Data and Machine Learning for Predicting and Evaluating the Carbon Reduction Potential of Clean Energy," 2025 International Conference on Intelligent Communication Networks and Computational Techniques (ICICNCT), Bidar, India, 2025, pp. 1-5.

[14] Y. Zhao, "Design and Financial Risk Control Application of Credit Scoring Card Model Based on XGBoost and CatBoost, " 2025 International Conference on Intelligent Communication Networks and Computational Techniques (ICICNCT), Bidar, India, 2025.

[15] K. Zhang, "Optimization and Performance Analysis of Personalized Sequence Recommendation Algorithm Based on Knowledge Graph and Long Short Term Memory Network, " 2025 2nd International Conference on Intelligent Algorithms for Computational Intelligence Systems (IACIS), Hassan, India, 2025, pp. 1-6.

[16] Ding, J. (2025). Research On CODP Localization Decision Model Of Automotive Supply Chain Based On Delayed Manufacturing Strategy. arXiv preprint arXiv:2511. 05899.

[17] Wu Y. Software Engineering Practice of Microservice Architecture in Full Stack Development: From Architecture Design to Performance Optimization. 2025.

[18] Wu Y. Optimization of Generative AI Intelligent Interaction System Based on Adversarial Attack Defense and Content Controllable Generation. 2025.

[19] Sun J. Quantile Regression Study on the Impact of Investor Sentiment on Financial Credit from the Perspective of Behavioral Finance. 2025.

[20] Wang Y. Application of Data Completion and Full Lifecycle Cost Optimization Integrating Artificial Intelligence in Supply Chain. 2025.