Article

Research on Mobile E-Commerce App Experience Design Based on Flow Theory

Jinchi Sui [1,2,*] and Rina Abd Shukor [3]

[1] City Graduate School, Faculty of Creative Industry, City University Malaysia, Kuala Lumpur, Malaysia
[2] Hefei University of Economics College of Art and Design, Hefei, Anhui, China
[3] University Selangor, Selangor, Malaysia
* Correspondence: Jinchi Sui, City Graduate School, Faculty of Creative Industry, City University Malaysia, Kuala Lumpur, Malaysia; Hefei University of Economics College of Art and Design, Hefei, Anhui, China

Abstract: This study is grounded in flow theory and aims to investigate how applying flow-based design principles can enhance user engagement and satisfaction in mobile e-commerce apps. First, the paper reviews the core elements of flow theory and summarizes the current state of experience design research for mobile e-commerce apps, identifying common challenges and shortcomings in existing design practices. Next, it constructs an experience design model based on flow theory. By combining literature analysis with expert interviews, the study identifies key design dimensions — such as "challenge–skill balance", "immediate feedback", and "intrinsic motivation" — as the most influential factors for enhancing flow in mobile e-commerce experiences". In the design practice phase, a representative mobile e-commerce app is selected for prototype redesign. Usability testing and quantitative surveys are used to evaluate and analyze user experience. Research findings indicate that introducing appropriately challenging task guidance in interface interactions, strengthening real-time feedback mechanisms, and creating a guided achievement system can significantly enhance users' sense of immersion and willingness to continue using the app. Finally, based on user testing and empirical data, the paper summarizes several feasible flow-driven design strategies and offers suggestions for future research improvements and practical applications, providing theoretical and methodological support for mobile e-commerce platforms to build differentiated user experiences in an increasingly competitive environment.

Keywords: flow theory; mobile e-commerce; user experience; interface interaction; immersion

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1. Introduction

Mobile e-commerce apps have become the primary channel for daily shopping, but as the number of platforms rapidly increases, maintaining user retention and satisfaction has become a formidable challenge. Flow theory emphasizes elements such as "challenge–skill balance" that can trigger heightened focus and enjoyable experiences. Applying these principles to mobile e-commerce holds promise for boosting user immersion and sustained usage. This study synthesizes literature on flow theory and mobile e-commerce experience design, incorporates expert interviews to distill key design dimensions, and integrates multi-level task guidance, immediate feedback, and achievement incentives into a leading app's prototype. Usability tests and surveys are then conducted to assess the redesigned prototype's levels of immersion, satisfaction, and conversion performance. For clarity, the remainder of the paper is organized as follows. Chapter 2 reviews relevant theories and prior research; Chapter 3 details the research methods; Chapter 4 presents flow-based design principles; Chapter 5 describes design practice and test results; Chapter 6 summarizes findings and future directions.

2. Theoretical Foundation and Literature Review

2.1. Overview of Flow Theory

Flow theory, introduced by psychologist Mihaly Csikszentmihalyi in the 1970s, describes a state of deep focus, energy, and immersion experienced when engaging in an activity that matches one's skill level in difficulty. In flow, tasks are neither too easy (causing boredom) nor too difficult (causing frustration), which fosters sustained motivation and concentration. During flow, self-awareness diminishes, time perception alters, and thinking and action merge, yielding intrinsic enjoyment and peak performance. Crucially, clear goals and immediate feedback enable individuals to track progress and correct errors, maintaining uninterrupted focus. The conditions for flow are often summarized in nine elements: clear goals; focused attention; challenge–skill balance; immediate feedback; merging of action and awareness; loss of self-consciousness; altered time perception; exclusion of external distractions; and intrinsic autonomy. While studies highlight different aspects of these elements, together they create a deeply immersive and rewarding experience. Empirical research in education, sports, and the arts shows that achieving flow enhances creativity, sense of accomplishment, and willingness to persist, improving both performance and well-being. With the rise of mobile internet and smart devices, flow theory has been applied to digital user experience design [1]. Scholars assert that embedding flow elements — such as challenging tasks, real-time visual feedback, and clear operational guidance — enhances focus and satisfaction in contexts like games, educational platforms, and social apps. For example, online learning platforms segment material into levels and award badges upon completion, and games adjust difficulty dynamically to match player skills, prolonging immersion and enjoyment. In mobile e-commerce, researchers explore using flow theory to improve shopping experiences. By integrating appropriately challenging tasks (e.g., flash sales or level-up discounts), apps can encourage exploration and instant rewards. Additionally, smooth navigation, reduced friction, and highly visual progress indicators help users avoid anxiety and confusion, which in turn can ease entry into flow. Studies show that when e-commerce platforms incorporate flow-based elements on homepages or product pages, metrics such as dwell time, conversion rates, and repurchase intentions improve significantly. In summary, flow theory offers actionable principles — balancing task difficulty with ability, providing immediate feedback, and fostering intense focus — that extend beyond psychology into digital product design. Subsequent chapters will explore translating flow's nine elements into concrete interface dimensions and interaction strategies for mobile e-commerce apps to create deeply immersive shopping experiences [2].

2.2. Current Research on Mobile E-Commerce App Experience Design

Given the ubiquity of smartphones and mobile networks, mobile e-commerce apps are now the primary shopping channel. Existing research focuses on several areas:Interface Layout and Visual Design. A clean, intuitive navigation structure, prominent search and filter functions, and high-quality images and icons are essential for capturing user attention. For example, segmenting homepage products based on preferences and enabling horizontal swipes between large images and info tabs on product pages improves browsing efficiency and reduces cognitive load. Consistent color schemes and typography also enhance visual coherence and reinforce brand identity. Interaction Flow and Feedback. Apps must connect search, filtering, ordering, payment, and tracking into a seamless pathway. Design patterns such as one-handed operation, single-step countdowns, and sliding progress bars reduce steps and improve flow. Immediate feedback — animated button responses, highlighted filter results, and elastic cart-count animations — helps users understand their status and next actions, reducing anxiety [3]. Personalized Recommendations and Precision Marketing. Leveraging big data and machine learning, apps recommend relevant products or campaigns based on browsing, favorites, and purchase

history. Research not only evaluates algorithm effectiveness but also emphasizes interactive recommendation interfaces — horizontally scrollable "You May Also Like" sections, "Today's Deals" countdown timers, and pop-up suggestions for related items or bundles. Empirical results show that well-designed personalization boosts dwell time, conversion rates, and repeat purchases. Social and Entertainment Elements. Features such as live-streaming commerce, group buying, and short-video endorsements integrate social sharing, comments, and gamified tasks to enhance engagement. Embedding short videos in product pages or adding interactive modules like "bargain deals" and "daily check-in coupons" stimulates curiosity. Point systems and tiered incentives foster a sense of achievement and long-term engagement. Cross-Platform Consistency and Performance Optimization. To ensure stability across devices and networks, studies propose progressive image loading, local caching, and preloading, while stressing consistent layouts and interaction logic between desktop and mobile. A/B testing and real-user monitoring further refine interface details and entry points. In summary, research has evolved from visual aesthetics to encompass interaction flow, personalization, social entertainment, and performance. However, integrating these findings into a unified, flow-driven framework remains an important direction for future work [4].

3. Research Methods and Model

3.1. Research Framework and Process

Guided by flow theory, this study adopts a combination of literature analysis, expert interviews, prototype design, and user testing to construct a flow-based experience design model for mobile e-commerce apps. First, by systematically reviewing relevant domestic and international literature, the relationship between flow elements and e-commerce experience design is clarified, and key dimensions from exemplary design practices are summarized. Next, several rounds of semi-structured interviews are conducted, inviting mobile e-commerce product managers and user experience experts to jointly explore the feasibility and core metrics of applying flow theory in an e-commerce context, thereby providing empirical support for model construction. Based on the theoretical review and interview findings, the research team further distilled three core dimensions — challenge–skill balance, immediate feedback, and intrinsic motivation — to form a preliminary flow-driven experience design framework. On this foundation, a leading mobile e-commerce app is selected for interface and interaction prototype design, mapping the core dimensions onto specific modules and process nodes. Subsequently, the redesigned prototype is empirically tested through a combination of usability testing and an online questionnaire, including in-depth observational interviews, quantitative survey metrics, and analysis of back-end behavioral data [5]. In the data analysis stage, descriptive statistics and correlational analyses are applied to the user experience questionnaire to verify how the design improvements influence each flow dimension; simultaneously, behavioral log data is used to extract metrics such as user dwell time and click-heatmap distributions across different interaction scenarios, providing support for quantitative analysis. The entire study follows an iterative process that moves from theory to practice and from qualitative to quantitative methods, ensuring that the research findings possess both theoretical depth and practical value [6].

3.2. Data Collection and Analysis Methods

This study draws on five data sources: literature materials, expert interviews, usability testing, questionnaire surveys, and behavioral logs. First, we searched CNKI and Google Scholar for high-quality publications from the past five years on flow experience, mobile e-commerce, and user experience. These sources were assembled into a literature database and subjected to content analysis to distill key theoretical constructs and design practice elements. Next, three seasoned e-commerce product designers and two user-experience scholars participated in semi-structured interviews lasting approximately 60

minutes each [7]. Interview recordings were transcribed, coded, and thematically analyzed in NVivo to extract common perspectives and design recommendations, which were then used to guide the prototype design. During the prototype testing phase, the research team applied the identified flow-design framework to redesign the interface and interactions of a leading e-commerce app, producing a high-fidelity prototype. Twenty target users were recruited to perform tasks under a think-aloud protocol, with their action paths and subjective feedback recorded by the research team [8]. Simultaneously, participants completed the System Usability Scale (SUS), and screen-recording plus eye-tracking equipment captured click heatmaps, gaze trajectories, and page dwell times, supplying objective data for quantitative analysis. For the questionnaire survey, we employed Csikszentmihalyi's flow scale alongside a bespoke mobile-e-commerce experience questionnaire covering immersion, focus, satisfaction, and continuance intention. All items used a five-point Likert scale. Of 200 distributed questionnaires, 186 valid responses were obtained (93% validity rate). Sample demographics are summarized in Table 1.

Table 1. Participant Demographics.

Variable	Category	n	%
Age	18–24	60	32.3
	25–34	85	45.7
	35–44	30	16.1
	≥45	11	5.9
Gender	Male	102	54.8
	Female	84	45.2
Prior e-commerce use	<1 year	40	21.5
	1–3 years	75	40.3
	>3 years	71	38.2

Behavioral logs were captured during testing, recording clicks, page transitions, and browsing depth within the prototype environment to facilitate before-and-after comparisons of key metrics. In terms of analysis, interview data were subjected to thematic coding and inductive analysis to identify design elements and construct a flow-mapping model, while literature review findings were synthesized to establish a design-dimension framework. Questionnaire data were processed in SPSS 26.0 for descriptive statistics, reliability analysis, and exploratory factor analysis to verify the scale's structural validity and internal consistency; correlation and regression analyses then assessed the effects of individual flow elements on user satisfaction and continuance intention. Behavioral logs were parsed via custom scripts to generate heatmaps and behavior funnels. Paired-sample t-tests were then used to compare metrics such as average dwell time and click-through rates before and after the redesign, validating the efficacy of the design interventions. Finally, qualitative interview insights were cross-validated against quantitative findings to ensure that our conclusions are robustly supported by both theoretical and empirical evidence [9].

4. Experience Design Principles Based on Flow Theory

4.1. Challenge–Skill Balance and Immersion Design

Within flow theory, the "challenge–skill balance" is the core element that triggers user immersion. Applied to a mobile e-commerce app, tasks of moderate difficulty should be embedded at key stages such as onboarding, daily rewards, and promotional events, taking into account varying user cognitive levels and operational skills. Concretely, multi-level tasks such as "daily sign-in for coupons", "browse storefront for cumulative time", and "complete limited-time challenges" can be set on the home screen or promotional pages to spark user curiosity. Simultaneously, task requirements should be dynamically adjusted — such as matching task difficulty to a user's historical purchase frequency and

browsing habits — to ensure the challenges remain appropriately engaging (causing boredom) nor too difficult (leading to frustration) [10]. To reinforce immersion, the app must provide clear goals and real-time progress feedback during challenge tasks. For example, when a user participates in a "flash sale", prominently display a countdown timer and remaining stock on the page; when browsing items or joining a group-buying activity, show the number of participants and individual progress in real time, so that users are always aware of their current status and goal attainment. Such design helps users maintain sustained focus, minimizes external distractions, and creates a sense of time distortion characteristic of the flow state. Furthermore, in terms of interaction and visual presentation, a clean and coherent atmosphere should be fostered to avoid redundant information that interrupts users' thought processes. By employing techniques like staged loading, progressive animations, and sound cues, users receive immediate feedback with each completed operation, further strengthening their self-efficacy. For example, when a user adds an item to the cart or completes checkout, a pop-up animation can display accumulated savings or suggest the next task, thereby avoiding operational discontinuities. Overall, through a task mechanism based on "challenge–skill balance" and real-time feedback, user concentration and immersion can be effectively enhanced, prompting positive engagement and a delightful experience in the mobile e-commerce scenario.

4.2. Immediate Feedback and Intrinsic Motivation Mechanisms

Immediate feedback is an essential component for sustaining users' flow experiences. In a mobile e-commerce app, every user action should receive timely and clear responses to enhance their sense of confidence and control. For instance, when a user completes a task (such as signing in, sharing, favoriting, or making a purchase), the interface can instantly display reward information or task progress via animations, pop-ups, or sound cues, enabling the user to quickly perceive goal attainment. This prompt positive reinforcement not only gives users a sense of satisfaction but also encourages them to remain attentive to subsequent tasks or purchase behaviors, reducing frustration or uncertainty caused by waiting. Additionally, in various operational scenarios — such as button taps, adding a product to the cart, or successful payment — microinteraction effects can be designed so that users perceive the pleasure of interaction both visually and tactilely. The intrinsic motivation mechanism focuses on engaging users' internal drives so that they experience personal growth and accomplishment. A mobile e-commerce app can build a continuous goal-achievement pathway by introducing a leveling system, achievement badges, or cumulative points. When users reach predetermined achievement milestones, upgrade animations, medal displays, and a visually interactive "achievements center" can be triggered to stimulate their desire for further exploration and challenge. Moreover, by incorporating entertaining elements into recommended content and promotional activities — such as a "puzzle discount" that resembles a matching game or a "level-up flash sale" with checkpoint mechanics — users can enjoy a gamified sense of accomplishment while completing purchasing tasks. To further consolidate positive behaviors, based on users' past activity patterns, ensuring users remain in a "challenge–skill" equilibrium state. In this way, users not only feel satisfied but also experience growth and fun during their shopping process. Immediate feedback and intrinsic motivation work in tandem to create an atmosphere of focused engagement, enabling users to sustain a flow experience while using the mobile e-commerce app, ultimately fostering greater user stickiness and higher conversion rates.

5. Design Practice and Case Analysis

5.1. Typical Mobile E-Commerce App Design Scheme

Based on the flow-theory-driven experience design principles proposed in this study, a prototype redesign was conducted for a leading mobile e-commerce app. The overall scheme is reflected in the following four aspects: A three-tier task structure — "Check in

for coupons", "Accumulate browsing time", and "Limited-time bargaining" — is laid out. A collapsible task panel is embedded on the app's home page, and task difficulty is dynamically adjusted based on each user's purchase history and browsing patterns. For example, new users must complete three days of check-ins to unlock exclusive discounts, while active users join the "Ten consecutive orders for discounts" activity, ensuring that tasks remain engaging without becoming overly burdensome. Microinteractions and visual progress indicators are introduced at key touchpoints. When a user taps the "Add to Cart" button, the shopping cart icon performs an elastic animation and simultaneously displays the points earned. On the "Flash Sale" page, a countdown timer and remaining stock are continuously shown at the top. After tapping "Join Now", the app immediately navigates to the purchase screen and highlights the selected item in red, giving users real-time status cues. The user's sense of achievement is strengthened through an achievement and points system. The redesigned prototype adds an "Achievements Center" on the "Profile" page. When users reach predefined milestones — such as completing consecutive daily tasks or reaching a spending threshold — an achievement badge animation is automatically triggered, and corresponding reward points are granted. Badges can be viewed in the Achievements Center and shared on social media, satisfying users' needs for self-expression and self-affirmation. A clean, consistent color scheme is paired with streamlined interface layouts and progressive loading patterns to reduce unnecessary interface clutter that could disrupt user focus. On the product details page, products, promotions, and reviews are displayed in separate sections that users can swipe between horizontally, reducing excessive vertical scrolling. A 0.5-second "micro-feedback" sound effect is also added to ensure that each action produces a positive perception. By organically combining flow elements such as challenge–skill balance, immediate feedback, and intrinsic motivation, the overall redesign allows users to experience both enjoyment and a continuous sense of achievement while completing shopping tasks, thereby enhancing immersion and user retention.

5.2. User Testing and Experience Evaluation

Usability testing was conducted on a mobile device with twenty target users interacting with the high-fidelity redesigned prototype. Each participant received an overview of the study and then completed three representative tasks — "Check in for coupons", "Participate in a flash sale", and "Negotiate a bargain" — while thinking aloud to verbalize their thought processes and emotional reactions. Screen recording captured click paths and navigation flows throughout. Upon finishing the tasks, participants completed the System Usability Scale (SUS) questionnaire, rating perceived ease of use, task-flow smoothness, and overall satisfaction. Concurrently, objective metrics were logged, including dwell time at each interaction point, click-heatmap distributions, and task-completion success rates, to enable quantitative comparisons before and after redesign (Table 2).

Table 2. Key Metrics before and after Redesign.

Metric	Original Version	Redesigned Prototype	Change (%)
SUS Score	67.8	82.5	+21.6%
Average Dwell Time on Flash Sale	35 s	52 s	+48.6%
Task Completion Success Rate	78%	94%	+20.5%
Continued-Use Intention (Likert)	3.2	4.1	+28.1%

In data analysis, SUS scores underwent descriptive statistics and paired t-tests, revealing that the redesigned prototype's mean score (82.5) exceeded the original by nearly 15 points, confirming significant usability gains. Think-aloud transcripts reflected praise for "clear guidance in the task panel", "immediate system feedback", and "motivating badge animations". Objective logs showed average dwell time on the Flash Sale page increasing from 35 s to 52 s, indicating deeper engagement, while task-completion rates climbed from 78% to 94%, validating that enhanced challenge–skill balance and feedback

mechanisms strengthened users' flow. To examine how flow elements affected continuance intention, we ran correlation analyses on responses to specific questionnaire items. Immersion correlated strongly with continuance intention ($r = 0.68$, $p < 0.01$), immediate-feedback correlated with task satisfaction ($r = 0.72$, $p < 0.01$), and intrinsic-motivation correlated with willingness to "join the next challenge" ($r = 0.65$, $p < 0.01$). Qualitative comments highlighted that real-time reward prompts and badge animations made users feel "energized to explore further", extending session length and improving conversion rates. Overall, both subjective SUS ratings and objective behavioral data demonstrate that the redesign markedly enhanced usability, immersion, and motivational dynamics. User feedback confirms that applying flow-theory–driven design principles in a mobile e-commerce context is both practical and effective, substantially boosting user focus, engagement, and readiness for broader deployment.

6. Conclusion

Guided by flow theory, this study proposed three design principles — challenge–skill balance, immediate feedback, and intrinsic motivation — to build a mobile e-commerce app experience model. The prototype redesign and user testing confirm that well-designed multi-level task guidance, real-time progress and reward feedback, and badges with points effectively enhance user immersion, satisfaction, and continuous-use intention. The redesigned prototype received high scores on usability evaluations, and behavioral data showed significant increases in session duration and task completion rates. This study validates the operability and value of flow elements in e-commerce scenarios and offers a practical reference for platforms aiming to create differentiated user experiences. Future research can further explore dynamic task generation and personalized recommendation strategies based on user profiles to continuously optimize flow-driven shopping experiences.

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