Journal on Interactive Systems, 2026, 17:1
ISSN: 2763-7719 • doi: 10.5753/jis.2026.4438

Research Paper

Evaluation of Immersion in the Flow State from the Variation of the Instagram Web Interface

Alice Cabral de Avelar Marques [Pontifical Catholic University of Minas Gerais | *alicecamarques@gmail.com*]
Humberto Torres Marques-Neto [Pontifical Catholic University of Minas Gerais | *humberto@pucminas.br*]

Department of Computer Science, Pontifical Catholic University of Minas Gerais, Av. Dom José Gaspar, 500, Coração Eucarístico, Belo Horizonte, MG, 30535-901, Brazil.

Abstract. *Background:* Social media interfaces employ design strategies that encourage continuous engagement, which may influence users' immersion and flow state. Investigating how interface design elements contributes to inducing a flow state in users is essential to promote ethical and mindful design practices. *Purpose:* This study aims to explore the impact of Instagram's interface design on user behavior, with a particular focus on indications of the flow state. *Methods:* We developed a browser extension based on the Hook model to carry out interventions in the interface, aiming to remove triggers, reduce rewards, and limit user actions. A case study was conducted with undergraduate students who navigated both the modified and standard Instagram web interfaces. The Online Flow Questionnaire was used to measure flow state levels and, additionally, participants who used the extension took part in a brief interview to gather qualitative insights about their experience. *Results:* Findings indicate a subtle variation in the flow state between the modified and standard interfaces, suggesting that interface changes influence user's flow state. Results also suggest that the device type can modulate the flow state and that individual factors, such as technological familiarity, can influence user interaction. *Conclusion:* Interface design elements encourage users to remain engaged for longer periods, providing an initial indication of the impact of design on user flow state. The findings reinforce the need for ethical design approaches that balance user retention with mental well-being.

Keywords: Human-Computer Interaction, Flow State, Instagram, User Interface Design, Ethical Design

Edited by: Roberto Pereira | **Received:** 23 April 2024 • **Accepted:** 14 October 2025 • **Published:** 01 January 2026

1 Introduction

Human-Computer Interaction (HCI) studies the interaction between people and computers, and its focus has traditionally been on the human being and how to ensure that technology meets the demands of users in the best possible way [Stephanidis *et al.*, 2019]. The need to understand users and their interactions with technology has motivated a turn towards the user experience within HCI and design [McCarthy and Wright, 2004].

In order to satisfy users' needs, an effective interface must offer access to the application's functionalities and align with the manner in which users conceptualize the tasks supported by the interface. This requires that the application not only provides support for the necessary aspects of the users' work, but also provides the means for them to interact with the application in an intuitive and natural way [Wood, 1997]. The resulting concepts, known as User Experience (UX) design and User Interface (UI) design, collaborate to create a cohesive and positive experience for the user.

While these principles are widely applied in the development of various platforms, this work focuses on the context of online social networks, with an emphasis on Instagram. Social media design often uses persuasive techniques to enhance the user experience and increase interaction and retention, and is intentionally designed to be addictive and exploit vulnerabilities in human psychology [Alutaybi *et al.*, 2019]. This approach has the potential to create a sense of dependency and behavior disorder [Santoro and Costa, 2021], as users develop a recurrent and, any times, obsessive use of the platforms.

With this effort to transform the use of social networks into an automatic habit that requires little conscious control [Baughan *et al.*, 2022], the user can reach the flow state, a concept developed by Mihaly Csikszentmihalyi, in 1999. The flow state, in its broad sense, is defined as any change in behavior that is directly linked to focus. It can be defined as a mental state that occurs when a person carries out an activity and feels totally absorbed in a sensation of energy, pleasure, and total focus on what they are doing, generating a complete immersion and a consequent loss of sense of space and time [Csikszentmihalyi, 1999].

Although the flow state has the potential to provide momentary satisfaction, excessive immersion can result in adverse consequences for mental health and well-being. Studies have linked excessive use of social media with negative impacts on psychological well-being [Huang, 2017]. In this context, it is imperative to conduct in-depth research to investigate the patterns that trigger such adverse effects on users' attention, thereby substantiating the purpose of this study.

In this scenario, this work investigates how Instagram's interface design contributes to inducing a flow state in users. The main goal of this study is to explore the impacts on Instagram's user behavior, focusing on indications of the flow state. To achieve the aforementioned purpose, the following specific objectives were outlined: (i) developing a Google Chrome extension that modifies the Instagram interface; (ii) observing variations in users' flow state with and without the extension; and finally, (iii) investigating potential relationships between interface design and user immersion in the flow state, providing preliminary insights into its implications.

The methodology of this work consisted of developing the Less Insta Flow extension for Google Chrome, which intervened in the Instagram interface to dispense triggers, reduce rewards, and limit user action. Therefore, an experiment was conducted with university students that involved browsing Instagram via Google Chrome with and without the extension activated over the course of one week. This was followed by the administration of questionnaires and interviews to evaluate the participants' experience.

The findings indicate that the interventions introduced into the Instagram interface had a subtle impact on users' flow state. Although the average flow state was lower for extension users, suggesting a potential influence, it is crucial to consider the predominant context of Instagram use on mobile devices and the limited and convenience-based sample. The thematic analysis of interview data provided additional qualitative insights, revealing how users perceived and adapted to the modified interface. The modifications aimed at dismissing triggers proved successful, as participants were not negatively impacted by the absence of the triggers. Meanwhile, the alerts designed to reduce rewards effectively encouraged greater awareness of users' own behavior. In contrast, the interventions intended to limit user actions showed a more moderate effect, suggesting the need for more robust functionalities to better restrict these specific interactions. Differences observed across undergraduate courses raise the hypothesis that participants' technological familiarity may have influenced the results. Overall, this study contributes to a deeper understanding of the role of interface design in shaping the user experience on social networks, highlighting the complexity of the flow state and the ethical balance between user retention and mental well-being.

The article is divided into five sections. Section 2 presents a theoretical framework, offering an overview of the main themes and concepts employed. A comprehensive review of the extant literature on the subject is provided in Section 3. This review forms the foundation for the arguments presented in the article. The fourth section delineates the methodology employed, covering the implementation of the extension and the experiment setup. Section 5 expounds upon and engages in a discursive examination of the findings that were obtained. Ultimately, the final section arrives at a conclusion of the article, highlights the limitations of the study and evaluates possible future work.

2 Theoretical Background

This section will explore the influence of UI design on user behavior, the excessive use of Instagram and its impact on immersion in the flow state, as well as the concept of flow state in various activities.

2.1 User Interface Design

User Interface design is the process of building interfaces with a focus on the user's experience and interaction, playing a fundamental role in modeling the user's behavior in a given application. It is used on several platforms, like websites, apps, and software. The goal of UI design is to make it so that users can interact with it easily and efficiently. The design process must balance theoretical functionality and visual elements to create a system that is not only operational, but also usable and adaptable to the changing needs of the user [Cox and Walker, 1993].

If well executed, UI design allows for a more satisfying experience, making it easier for users to achieve their goals. On the other hand, if an interface is poorly designed, the user's ability to take advantage of an application's computing power can be severely jeopardized [Sridevi, 2014]. Thus, the importance of user interface design goes beyond aesthetics, influencing directly the way users interact and engage with an application.

2.2 Excessive Use of Instagram

Instagram covers a diverse range of functionalities, allowing its users to edit and post photos and videos, interact through comments and likes, follow and be followed by other profiles, as well as exploit features such as live videos and short-form content. However, these features also present a challenge, as they can contribute to the excessive and sometimes addictive use of this social network [Kircaburun and Griffiths, 2018], establishing a direct correlation with immersion in the flow state. People impulsively check the number of notifications (likes and comments), upload photos, videos and keep up to date with other people's profiles [Sholeh and Rusdi, 2019]. In 2025, Instagram had 2 billion monthly active users access the app globally, spending an average of 33.9 minutes a day on the platform [Backlinko Team, 2025].

2.3 Flow State

The concept of flow describes a state in which a person is deeply immersed in an activity. Csikszentmihalyi [1999], the pioneer of this concept, points out that the flow state manifests itself when goals are clear, feedback is immediate, and there is a balance between the challenges of the situation and the individual's abilities. In this state, the individual's attention becomes ordered and receives total investment, resulting in total concentration. During the flow state, there is a distorted temporal experience and a loss of self-consciousness, leading to the mind's exclusive focus on the present action. According to Csikszentmihalyi [1999], as long as these elements are present, any activity has the potential to induce a flow state.

3 Related Work

The related work selected for this study's literature review explore themes encompassing the flow state, the sense of action (or sense of control), social networks (such as Instagram, Facebook, TikTok and YouTube), design and user experience. The focus lies primarily on Human-Computer Interaction (HCI) and the psychological impacts associated with excessive use of social networks, particularly addictive behaviors influenced by design-driven mechanisms.

Lyngs *et al*. [2020] describe an experimental study investigating how design interventions can help people control their behavior on Facebook. Participants were exposed to different types of interventions, including notifications, visual feedback, and access blocking, and the results show that the combination of visual feedback and access blocking was the most effective in reducing the time spent on Facebook and the frequency of use of the social network. The study highlights the importance of design in promoting healthier and more conscious behavior on social media.

In the same way, Purohit *et al*. [2020] discuss the application of digital nudges to make social media less addictive and help people take a digital detox. To combat this problem, the authors propose a set of digital nudging techniques that can help users disconnect from social media and have a better balance between time spent online and offline.

Likewise, Baughan *et al*. [2022] explore how the design of social media platforms can influence users' cognitive dissociation, leading them to consume information without actually processing or remembering it. Through a literature review and interviews with social media users, the authors argue that the design of platforms such as Facebook and Twitter can lead users to experience a sense of "zone" or "trance", where they lose track of time and space and are unable to retain information due to the constant flow of content. The authors suggest that technology companies should carefully consider the design of their platforms to help users engage more actively with the content they consume.

Relating social networks to the concept of FOMO (Fear of Missing Out), Alutaybi *et al*. [2019] explore how social networks are designed to generate the feeling of FOMO in their users. FOMO is a feeling of anxiety that arises when people fear they are missing out on something important or interesting that others are experiencing. The article discusses how the design elements of social networks, such as notifications, personalized feeds, and the display of friends' recent activities, can encourage FOMO. In addition, the article highlights the negative impacts of FOMO on mental health and suggests some approaches for people to deal with the problem.

Another concept that can be related to the excessive use of social networks is the concept of sense of agency. In their work, Baumer *et al*. [2018] explore this concept as a way of understanding transitions in the use and non-use of social media. The authors argue that a sense of agency is a useful tool for understanding how people make decisions regarding the use of social media and how they negotiate their participation in these platforms. In addition, the authors also examine how negative experiences can affect a person's sense of agency and lead them to abandon or reduce their use of social media.

Lukoff *et al*. [2021] also explore this same concept of sense of agency in their study. They investigate how the design of the YouTube platform affects users' sense of agency, that is, the feeling of having control and influence over their actions on the platform. The authors argue that the design of the platform, including features such as the search bar and recommendation algorithms, can affect users' perception of their ability to choose and control their behavior on the platform. The results of the study suggest that platform design can affect users' sense of agency and that it is important to consider these effects when designing user interfaces.

Furthermore, the concept of flow state is also related to the use of social networks, as Roberts and David [2023] examine in their paper. The authors explore the relationship between the use of Instagram and TikTok, the states of flow that users experience while they are on them, and their impact on psychological well-being. The research suggests that TikTok use is more likely to induce states of flow than Instagram, and that these states are associated with higher levels of psychological well-being. In addition, the results show that the amount of time spent on these social networks does not have a clear relationship with psychological well-being, but the quality of the experience does.

Focusing more on the use of social networks on smartphones, Tran *et al*. [2019] present a mathematical model to describe the dynamics of compulsive smartphone use. The model considers the interaction between four factors: impulsivity, attention, reward and abstinence. These factors influence the user's decision-making regarding smartphone use, leading to a cycle of engagement and disengagement that can lead to addiction. The model has important implications for the development of preventive and therapeutic interventions for smartphone addiction.

As in the Lyngs *et al*. [2020] study, this article also seeks to carry out an experimental study that investigates design interventions, however, these interventions will be carried out on Instagram and with a sample of participants characterized by undergraduate students. In addition, this work aims to relate these interventions to immersion in the flow state when browsing social networks, a concept also explored by Roberts and David [2023].

4 Methodology

The methodology of this work involved the development of an extension for Google Chrome, followed by user testing to evaluate its impact. Participants browsed Instagram both with and without the extension activated and, to measure the users' flow state, the Online Flow Questionnaire was applied. Additionally, participants who used the extension took part in a brief interview, aimed to gather qualitative insights into their experience, perceptions and reactions to the interface interventions.

4.1 Less Insta Flow Extension

To explore how the design of the Instagram interface contributes to inducing a flow state in users, we developed a Google Chrome extension. This extension, named *Less Insta Flow*, uses HTML, CSS, and JavaScript to make interventions in the Instagram user interface.

Figure 1. Interface of the Less Insta Flow extension

These interventions are based on the dynamics of the Hook model (see **Figure 2**). This model, adopted for the development of social media products, describes an interactive four-phase process for the design of software that encourages habit building. The process starts with a trigger, which leads to an action, produces a reward, and finally creates an investment. These four phases produce an addictive feedback loop in which the more users receive rewards and invest, the more they are encouraged to respond to triggers and perform actions

that, in turn, produce more rewards and investments [Purohit *et al*., 2020].

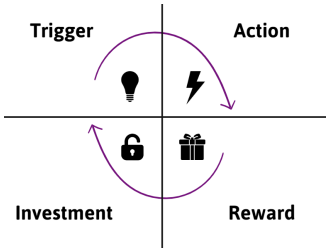

Figure 2. Hook model

Triggers serve as the initial cues that set habit formation in motion. For example, a notification signaling the arrival of a new message can prompt the user to engage with the application. In addition to triggers, providing users with rewards following their actions reinforces engagement and encourages repeated interaction with social media platforms. These rewards may take the form of social validation, such as comments and likes, or the continuous consumption of novel content, exemplified by features such as the infinite scrolling feed.

The interventions implemented on the Instagram interface upon activation of the Less Insta Flow extension can be categorized as follows: *dismissing triggers*, *reducing rewards*, and *limiting user actions*.

4.1.1 Dismissing triggers

While browsing Instagram, users who receive a direct message notification are likely to view and respond to it, continuing their interaction on the platform. These notifications function as triggers, prompting users to access and remain engaged with the application. For this reason, the removal of direct message notifications is one of the interventions implemented by the Less Insta Flow extension.

Similarly, when users scroll through the Instagram feed without updating it for a while, a "New posts" button often appears at the top of the screen so the user can click it and see more recent posts. This element also acts as a trigger, encouraging users to refresh the feed, view additional content, and prolong their usage. The removal of this button constitutes another key intervention of the extension, aiming to reduce compulsive engagement patterns.

4.1.2 Reducing rewards

Another relevant element is the "Notifications" icon, which displays information such as new likes, comments on the user's posts, and new followers. These notifications serve as clear examples of social validation rewards, one of the core mechanisms driving engagement on Instagram. Consequently, we removed this icon as part of the extension's interventions. This measure seeks to reduce the immediate gratification associated with such feedback, which often contributes to prolonged user retention on the platform.

To further reduce the effect of reward-based mechanisms, we also made modifications to the infinite feed, Stories, and Reels. It is particularly common, especially with Reels, for users to enter a repetitive and compulsive cycle: they watch a short video, experience immediate gratification, and quickly move on to the next. A similar pattern occurs with the feed and Stories, where users scroll through numerous posts without noticing how much time has passed or how many posts they have consumed. To address this behavior, a pause alert was implemented after every sequence of 10 posts, Stories, or Reels, displaying the number of items viewed. This intervention seeks to encourage users to become more conscious of their browsing habits, promoting a more reflective and controlled interaction with the platform.

4.1.3 Limiting user actions

Both the mobile and desktop versions of Instagram include a "Suggested for you" section, which recommends user profiles to follow based on one's existing network of followers and followed accounts. Although this content is not of initial interest to the user, it encourages further exploration of new profiles and continued use of the platform. In the same way, the "Explore" icon leads to a feed of posts from accounts the user does not follow, but that are algorithmically related to their browsing behavior and preferences. Despite not being directly sought out by the user, these features stimulate prolonged engagement through the constant presentation of new and potentially appealing content. To counter this dynamic, we removed both the "Suggested for you" section and the "Explore" icon. This intervention aims to limit user action and prevent them from engaging with material they weren't initially interested in.

With the same objective of limiting impulsive user actions, both the Stories and Reels sections were disabled by default. Although these features remain accessible, the user must perform an additional step: manually click a button to activate them. This intervention introduces a moment of friction that interrupts automatic behavior and encourages conscious decision-making.

Table 1 summarizes the interventions developed, their purpose based on Hook's model, and the motivations behind their development.

Figures 3, 4, 5, and **6** provide a detailed view of the Instagram interface, highlighting the changes resulted from activating the extension. **Figure 3** shows a comparison between the modified and the standard sidebar. The explore icon and the notifications icon have been removed, as well as the direct message notifications. In addition, the reels have been disabled, requiring the user to click on the eye button to make them available.

Figure 4 compares the Stories section. It is evident that, with the extension activated, the stories have become disabled, necessitating the activation of the eye button to enable their functionality, as it is to the reels.

Figure 5 shows the alert that is displayed every 10 viewed posts, appearing in the feed as well as in Stories and Reels. The alert message is updated concomitantly with the number of posts viewed by the user. When the alert appears, the interface is inaccessible, and the user is obliged to click "OK" to proceed browsing.

Finally, **Figure 6** displays a comparison between the complete Instagram home screen before and after activating the extension.

The Less Insta Flow extension code is available on

Table 1. Interventions carried out by the Less Insta Flow extension.

Intervention	Purpose	Motivation
Hide direct message notifications	Dismiss trigger	Reduce curiosity triggered by notifications
Hide "New posts" button	Dismiss trigger	Reduce curiosity about new posts
Hide notifications icon	Reduce rewards	Minimize the impact of social validation (likes and comments)
Pause alert in feed, stories and reels	Reduce rewards	Introduce friction to promote user awareness
Hide "Suggested for you"	Limit user action	Remove non-essential content
Hide explore icon	Limit user action	Remove suggestions of profiles not followed by the user
Button to enable reels and stories	Limit user action	Introduce friction to promote conscious navigation

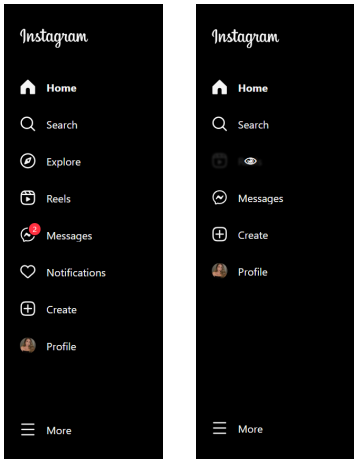

Figure 3. Standard sidebar *versus* with extension activated

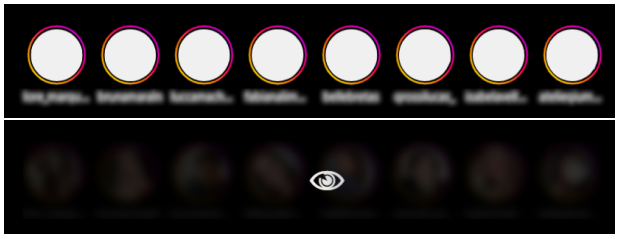

Figure 4. Standard stories *versus* with the extension activated

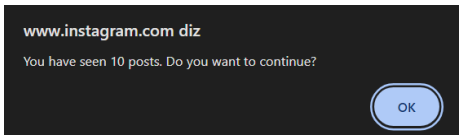

Figure 5. Post count alert

GitHub[1], accompanied by comments regarding its implementation and reproduction.

4.2 Test Setup

A test was carried out with 22 undergraduate students, aged between 21 and 30, from different courses and universities in Belo Horizonte, MG, Brazil. Participants were recruited through convenience sampling: we invited approximately 35 acquaintances and colleagues, and 22 agreed to participate. Due to the convenience-based recruitment, a considerable number of participants were Computer Science students, which corresponds to our own field of study, although students from a variety of other courses, including Medicine,

[1]`https://github.com/alicecabral/less-insta-flow`. Accessed on 17 December 2025.

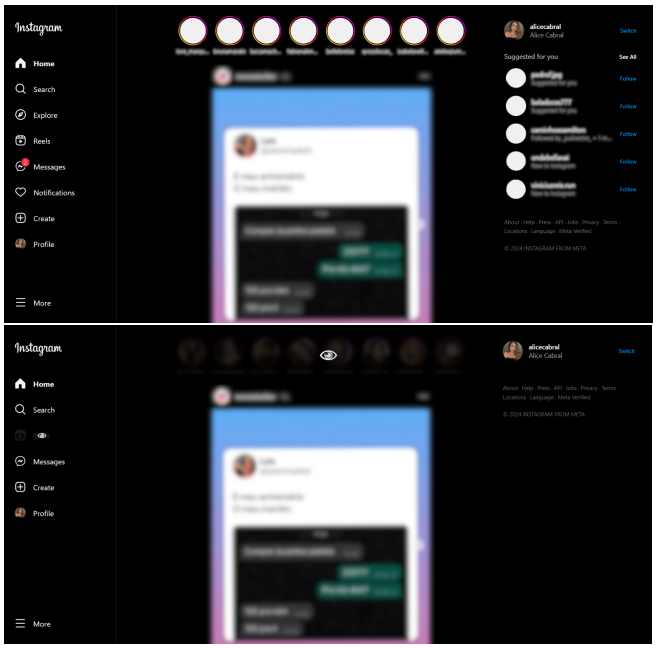

Figure 6. Standard instagram homepage *versus* with the extension activated

Psychology, Production Engineering, Mechanical Engineering, Economic Sciences, Advertising, and Mathematics, were also represented (see **Figure 7**).

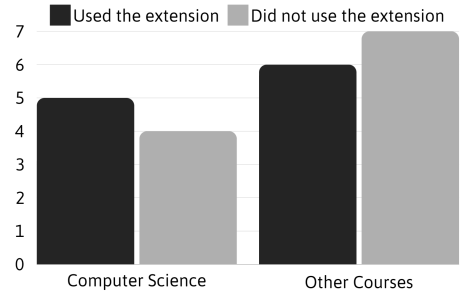

Figure 7. Distribution of usage of the Less Insta Flow extension by undergraduate course

The experiment, which took place over one week, required each participant to browse Instagram via Google Chrome while using their computer. At the end of this period, participants responded to a questionnaire that evaluated their flow state during this experience.

To conduct the test, the participants were divided into two groups, each with 11 individuals. The first group used Instagram normally, without any changes to the interface design, while the second group used Instagram with the Less

Insta Flow extension activated, i.e., with the design interventions previously mentioned. As the extension is not published, each participant in the second group received a .zip file and inserted it manually into their browser using a tutorial. This tutorial can also be accessed on GitHub.[1]

4.3 Online Flow Questionnaire (OFQ)

The Online Flow Questionnaire (OFQ) was utilized to measure the participants' flow state while engaging with the Instagram platform. This questionnaire is a notable and widely used instrument for assessing online flow [Hu *et al*., 2019]. It consists of five items, in which the participant must answer with "Yes" (score = 1) or "No" (score = 0). These items assess some of the characteristics present in the flow state. The answers are summed in a range from 0 to 5, with 0 indicating a minimum and 5 indicating a maximum rate of online flow experiences.

To adapt the OFQ to the context of this research, the questions were specifically directed at Instagram use rather than web use in general. In the original version, each question contains the phrase "when browsing online", which was replaced by "when using Instagram on the computer this past week". In addition to the five items, three supplementary questions were included to gather data on participants' frequency of Instagram use on both mobile phones and computers.

This adaptation involved a minimal contextual modification that aimed to align the instrument with the investigated context, without altering its original structure or conceptual meaning. As a result, the key aspects assessed by the OFQ, such as focused attention, enjoyment, and sense of control, remained unchanged. Although a specific validation of this adapted version was not performed, its use is justified by the preservation of the questionnaire's theoretical foundation and by the need to ensure contextual relevance to the platform under study. The adapted questionnaire is included in the appendix to this article.

In addition to the OFQ, participants in the second group, who used the extension, underwent a qualitative interview to provide more detailed information about the experience. We requested descriptions of the experience, emotional and behavioral reactions, and reflections on the impact of variations in the interface.

4.4 Ethical Procedures

Prior to the start of the experiment, a Term of Consent was prepared, based on the template provided by the Vice-Rectorate for Research and Gradudate Studies at PUC Minas. The document provided a concise overview of the research participation process and ensured the confidentiality of the collected data. All participants provided their signatures on the term, thus authorizing the utilization of their responses for academic purposes, but with the guarantee that the results would always be presented as the portrait of a group, not individually. Both the signed documents and questionnaire answers are in our possession and will not be shared to protect the privacy of those involved. The Term of Consent is available on GitHub.[1]

The study received formal ethical approval from the Research Ethics Committee (CEP) of PUC Minas, in compliance with the Brazilian National Health Council Resolution CNS 466/2012.[2] The project was approved under the Certificate of Presentation for Ethical Appreciation (CAAE) number 93670925.6.0000.5137, confirming that all ethical safeguards were followed, including voluntary participation, informed consent, protection of privacy, and confidentiality of personal data.

5 Results and Discussions

This section details and discusses the results of the case study that investigated indications of flow state variation resulting from changes in Instagram's web interface.

Regarding the sample, it should be noted that the group is small and the age and cultural characteristics are quite similar. For this reason, the analysis for these variables will not be performed separately. The genre will also not be considered a factor in the analysis, as the tool is relatively balanced among its users — 47.7% of Instagram users are female, slightly outnumbered by males, who make up 52.3% of the global user base. [Oberlo, 2024]

Attempting to segment the data based on these categories would result in less representative observations. Given the limited sample size and the challenges of recruiting participants willing to use the Less Insta Flow extension consistently for one week, the results are best viewed as indicative trends rather than definitive evidence, offering insights for future research.

5.1 Flow State in Different Devices

When analyzing the participants' flow state, a subtle variation was noted between those who used the Less Insta Flow extension and those who did not. The average flow state (on a scale of 0 to 5) of users and nonusers of the extension was 1.82 and 2.18, respectively (see **Table 2**).

Table 2. Average (μ) and standard deviation (σ) of the participants' flow state

	μ	σ
Did not use the extension	2,18	1,47
Used the extension	1,82	1,66

This disparity suggests that the use of the extension has the potential to influence the participants' flow state. However, it is important to note that even among the participants who did not use the extension, the maximum flow state was not reached. This observation raises the hypothesis that Instagram, when accessed from a computer, is likely to induce the flow state less intensely than when accessed from a cell phone.

This tendency is corroborated by the results of the Continuous National Household Sample Survey (PNAD Contínua), which indicates that the cell phone is still the main device for accessing the internet in Brazil [Assessoria de Comunicação Social - ASCOM, 2022]. This finding is aligned with the results of the research, in which participants in both groups of the study confirmed that they use Instagram significantly more often on their cell phones than on their computers. The answers to the questionnaire revealed that the majority of participants use Instagram on their cell phones daily, for

[2] `https://bvsms.saude.gov.br/bvs/saudelegis/cns/2013/res0466_12_12_2012.html`. Accessed on 17 December 2025.

more than two hours, while on their computers, the frequency is predominantly "two or three times a week" or "never or almost never", (see **Figure 8**).

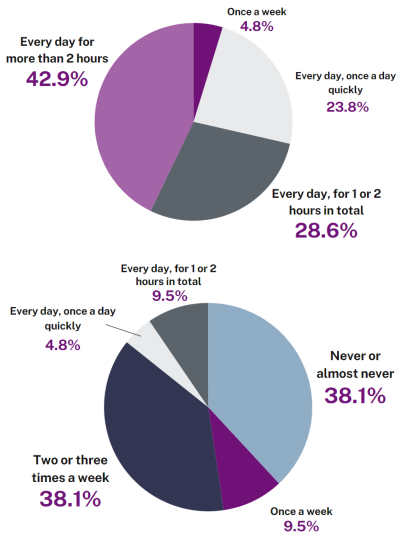

Figure 8. Frequency of Instagram usage by mobile phone and computer, respectively

One participant highlighted this difference when she said: *"In my case, the extension would only fulfill its function if it was on my cell phone. I don't use Instagram much on my computer and, when I do, I usually stay on it less"* (MC, 24). This individual perspective highlights the relevance of the context of use, reinforcing that individual preferences and patterns of behavior can influence the effectiveness of the extension, especially considering the preference for mobile browsing on Instagram.

Furthermore, the relatively low flow levels observed in this study are consistent with the findings of Roberts and David [2023], who reported that TikTok users experience overall higher levels of flow than Instagram users. According to the authors, TikTok's design encourages continuous consumption through an endless stream of short, entertaining videos, which provide constant reinforcement and contribute to the flow state. In contrast, Instagram's interaction patterns, particularly on its web interface, require more deliberate navigation, what could result in a less intense flow experience. Although Instagram introduced the Reels feature a few years ago, which has similarities to TikTok, it remains secondary to the feed, that is the platform's primary function.

5.2 User Experience and Flow State on Modified Instagram Web Interface

As previously indicated in **Table 2**, the use of the Less Insta Flow extension can influence, even if subtly, the participants' flow state, since the average flow state of users of the extension (1.82) was lower than that of nonusers (2.18). To complement quantitative findings, a thematic analysis of participants' interviews was conducted to extract patterns from their experiences and perceptions. There were three dominant themes that emerged from this analysis: the *unnoticed removal of persuasive triggers*, *awareness and self-regulation through interruption*, and *ease of bypass and habit persistence*. These themes provide a deeper understanding of how the interface variations influenced user experience and behavior.

5.2.1 Unnoticed removal of persuasive triggers

Interventions intended to dispense triggers, such as the removal of notifications and the "New posts" button, went virtually unnoticed by most participants. Several users mentioned that they "did not miss likes or notifications", suggesting that the removal effectively neutralized triggers without causing friction or frustration, consequently impacting the participants' experience. This finding supports the idea that subtle interface adjustments can mitigate persuasive design effects while maintaining usability.

5.2.2 Awareness and self-regulation through interruption

The alert containing the number of viewed posts, which was intended to reduce rewards, had the greatest impact on users' experience. Many participants reported that, although initially disregarded, the repeated appearance of the alert led them to reflect on their usage, becoming more aware of their actions and interrupting their use of Instagram in response to this notification. One participant commented, *"When I first saw the notification every 10 posts, it didn't bother me. But when it kept popping up I thought 'Wow, I've seen a lot' and it made me feel like I needed to leave Instagram"* (JS, 21). Others mentioned similar experiences, noting that the alert "gave them insight into their behavior and addiction".

This finding resonates with the mindfulness theme described by Purohit *et al.* [2020], in which digital nudges made users mindful of their actions. In their study, participants reported that subtle interventions, such as progress notifications, encouraged them to "stop mindlessly scrolling" and become more conscious of their online activity. Similarly, in this study, the post-count alert functioned as a digital nudge, creating moments of awareness that allowed users to self-regulate and momentarily disengage from the platform. Such mechanisms suggest that well-designed interruptions can effectively prompt self-awareness and voluntary disengagement, thereby minimizing the flow state.

5.2.3 Ease of bypass and habit persistence.

In contrast, modifications designed to limit user action, particularly the activation button to view stories and reels, had a minor impact. It was observed that the majority of participants continued to activate the button, mainly to view the stories. They emphasized that unlocking content felt "too easy" and, as one noted, *"Something that would help me is the option to block the reels permanently or for longer, because it was very easy to click on the 'little eye'"* (AP, 22). This limited impact can be attributed to the low level of friction introduced by these interventions: the activation button required minimal cognitive effort and could have not substantially disrupted the habitual interaction patterns established by Instagram's persuasive design.

The modifications designed to limit user action could be strengthened by increasing the friction of reactivation, for instance, introducing timed locks or confirmation prompts. Such approaches could better counteract the platform's automatic engagement triggers and more effectively influence the user's flow state. As discussed by Lyngs *et al.* [2020],

more restrictive interventions, such as the complete removal of the Facebook newsfeed that the authors experimented, can indeed prevent trigger-driven behaviors and promote self-control. Nonetheless, such measures also interfere with the platform's main features, significantly altering its intended user experience. In this sense, while a permanent blocking of Reels or Stories on Instagram could similarly reduce engagement triggers, it would compromise essential aspects of the platform's usability. Therefore, we argue that design interventions should favor subtle and reversible mechanisms that promote self-awareness and voluntary disengagement, rather than limiting user autonomy.

Together, these themes deepen the understanding of the quantitative findings, showing that while certain design changes can raise awareness and promote self-regulation, others may still lack sufficient strength to overcome ingrained habits of use.

5.3 Influence of Academic Background on Less Insta Flow Extension Use

When analyzing the average flow state considering the participants' undergraduate course, a discrepancy was identified in relation to the expected results. It was hypothesized that users of the extension, regardless of the academic background, would have a lower average than nonusers of the extension. However, in the context of the Computer Science course, the opposite result was observed (see **Table 3**). The average flow state for Computer Science students who used the extension was 2, while for those on the same course who did not use the extension, the average was 1.5.

Table 3. Average (μ) flow state separated by courses.

	Computer Science	Other Courses
Did not use the extension	1,5	2,3
Used the extension	2	1,67

A possible explanation for this outcome lies in the technological familiarity of Computer Science students. Being more accustomed to digital environments, these participants might have adapted more easily to the changes introduced by the extension. This academic background could also heighten their awareness of persuasive design elements, as students with a background in computing are generally more exposed to discussions about user experience and interface design. As AC (22), a Computer Science student, mentioned, *"Instagram truly has the effect of making you hooked. It has multiple mechanisms that work exactly to make you stay longer on the platform"*. Therefore, both their greater understanding of how such mechanisms operate and their habitual engagement with digital environments may have influenced how they perceived and responded to the interface modifications, potentially reducing the intended impact of the extension on the flow state.

Nevertheless, this remains a preliminary interpretation, as the present study did not actually measure participants' technical skills or technical knowledge. Therefore, this observation should be taken as an indicative tendency rather than conclusive evidence, pointing to an interesting direction for future investigation.

5.4 Ethical Analysis of the Less Insta Flow Extension

It is noteworthy that the persuasive design of social media platforms such as Instagram can be regarded as an ethical concern. The development of these platforms is frequently made in terms of cost/benefit, ignoring, or diminishing moral values that are difficult to represent or translate into financial/monetary terms [Santoro and Costa, 2021]. In this context, the user experience is shaped by engagement strategies that, while technically and commercially effective, can take advantage of cognitive and behavioral vulnerabilities of individuals.

As highlighted in the Brazilian HCI context, computational practices are not neutral, therefore, ethical analysis is essential to the design of applications [Carvalho *et al.*, 2022]. Despite the fact that computing gives us novel features and new opportunities for action (as evidenced by Instagram, which provides a variety of functionalities and stimulants to its users), we should consider deliberating on how these opportunities should be employed ethically and responsibly. As noted by Carvalho *et al*. [2022], ethics in HCI goes beyond legal compliance, as adherence to regulations such as the LGPD does not necessarily ensure ethical integrity. It requires examining how design decisions shape users' cognition, behavior, and autonomy.

Santoro and Costa [2021] suggests that, in light of this situation, we formulate strategies to guide our actions. One of these strategies could be the use of tools that would act like interaction mediators to these platforms, such as the Less Insta Flow extension. It can be used as a support tool during periods that require concentration, such as studying or working, and can be turned off during leisure time, according to individual preferences and perceived benefits.

A minor potential risk involved in the use of the Less Insta Flow extension is the feeling of frustration or discomfort caused by interface modifications that limit or delay certain actions. Additionally, self-awareness of social media habits, particularly due to alert messages aimed at reducing reward-seeking behavior, could cause another discomfort. These risks were mitigated in the experiment by ensuring that participants were fully informed of the experimental nature of the extension and had complete control over its use, which means that they could activate or deactivate it as needed. Also, the alert messages were phrased in a neutral tone, with emphasis on awareness rather than judgment, and, mainly, none of Instagram's essential features were permanently restricted, leaving the social media to function normally.

As Mirsch *et al*. [2017] highlight, digital platforms inherently use design elements to guide users' choices in online environments, producing psychological effects such as framing and status quo bias. Behavioral interventions, like those implemented with the Less Insta Flow extension, aim to counteract these automatic cues, promoting more deliberate and intentional use. While such interventions can temporarily disrupt habitual patterns or slightly increase cognitive load, potentially causing minor frustration, their primary function is to reduce the cognitive load caused by stimuli that capture and retain users' attention and to limit hasty, automatic decisions. In doing so, these interventions help balance the user

experience, supporting more conscious engagement with the platform.

5.5 Practical Implications for Social Media Designers

This study provides practical insights for designers of social media platforms. As Cunha and Aguiar [2020] highlight, every decision related to UI design influences user behavior, and designers must understand how their interfaces affect users' choices and actions. This perspective aligns with GranDIHC-BR (Grand Research Challenges in HCI in Brazil), which emphasizes that designers should be aware of the ethical impacts of their solutions [Rosemberg *et al*., 2014]. They should reflect on how intrusive their design choices might be and how significantly they can shape users' behavior. It is essential to ensure that interface design decisions do not compromise users' autonomy during the interactive process, while still supporting beneficial decision-making. Therefore, as "architects of choice", as described by Cunha and Aguiar [2020], designers should take responsibility for creating interventions that are non-exploitative, non-prohibitive, and choice-preserving, particularly in the context of software projects and, mainly, social media platforms.

6 Conclusion

This section summarizes the main findings of the study, highlighting the influence of Instagram's interface and the Less Insta Flow extension on users' flow states. We present key observations and implications, followed by a discussion of the study's limitations and directions for future research.

6.1 Summary of Findings

This study explored the influence of Instagram's web interface design on inducing the flow state in its users. When developing the Less Insta Flow extension, based on Hook's model, interventions were made in the interface to dispense triggers, reduce rewards, and limit user actions. Despite the absence of substantial numerical outcomes due to the limited sample size and to the predominant use of Instagram on mobile devices, the findings were noteworthy and strengthened the correlation between interface design, flow state, and user experience.

A subtle variation in the flow state was observed between users and nonusers of the extension. Although the average flow state of the extension users was lower as predicted, indicating a possible influence of variations in the interface, it is essential to consider the complexity of the phenomenon. The preference for using Instagram on a cell phone, as evidenced by the participants, highlights the importance of the context of use in determining the efficacy of interventions. Instagram, when accessed on a computer, may not induce the flow state as intensely as when accessed on a cell phone.

The thematic analysis of the interview data provided further depth to these findings, revealing how users perceived the interface modifications and how these perceptions influenced their engagement patterns. The interventions aimed at dispensing triggers proved effective and were largely imperceptible by users, while the alerts designed to reduce rewards had more significant impacts, generating awareness about user behavior. The interventions that limited user action, such as the requirement to activate certain features, exhibited a comparatively diminished impact.

The analysis by undergraduate course revealed that Computer Science students had a higher average flow state when using the extension, in contrast to the expected results. This suggests that the technological familiarity of these students could have played a role in their quick adjustment to changes in the interface, mitigating the effects of the extension.

In summary, the findings indicate that Instagram's interface design appears to influence the induction of the flow state, especially when accessed via mobile. Understanding these elements is crucial to balancing the quest for user retention with the promotion of mental well-being.

6.2 Limitations and Future Work

The present study faced certain limitations that must be acknowledged. Firstly, the sample size was reasonably small and only moderately diverse, as it was obtained by convenience, serving as an indicator rather than as evidence in itself. Moreover, given the limited sample size, no statistical power analysis was conducted. The study was exploratory in nature, aiming to identify indicative patterns rather than test hypothesis at a statistical level. The results, therefore, should not be interpreted as conclusive evidence but rather as indicators of potential relationships between interface design and the flow state in social media use. Future work involve enlarging and diversifying the sample, while also performing statistical power analysis to strengthen the assessment of effects related to interface design and the flow state.

Regarding the discrepancies perceived in the analysis by undergraduate courses and the hypothesis that technological familiarity and knowledge may have influenced participants' ability to adapt to interface modifications, future research could address this by segmenting participants based on their level of technological familiarity or self-assessed digital competence. This would allow for a more detailed analysis of whether higher technological familiarity neutralizes the intended effects of design interventions.

Another important limitation concerns the context in which the interventions were implemented. The interface changes to Instagram occurred on the web-based version of the platform, not on its mobile application. This was a choice that was technologically motivated, since intercepting or modifying a third-party mobile app would involve significantly higher complexity and potential risks. The use of a browser extension was a feasible way to operationalize the proposed interventions and to test their effects in a controlled manner. It is recognized, however, that Instagram's mobile app provides a more immersive and continuous experience, which could potentially produce more expressive and relevant results concerning the flow state. Nonetheless, the web-based interventions already revealed indications of how persuasive design elements can sustain user engagement and attention.

The findings, even within a limited scope, contribute to methodological advancement and offer possibilities for future research studying similar strategies on the Instagram mobile app or other social media platforms.

Declarations

Acknowledgements

We thank all the participants who generously devoted their time to this study. Their commitment and insights were essential to supporting this research.

Authors' Contributions

AC and HT contributed to the conception of this study. AC performed the software development, conducted the investigation and data collection, curated and analyzed the data, and wrote the original draft of the manuscript. HT supported and supervised the methodological design and data analysis, and substantially revised the manuscript. All authors read and approved the final version of the manuscript.

Competing interests

The authors declare that they have no competing interests.

Availability of data and materials

The materials generated and analyzed in this study (including the source code of the Less Insta Flow extension, installation instructions, adapted Online Flow Questionnaire, consent forms and the official Research Ethics Committee approval) are publicly available in the following repository: https://github.com/alicecabral/less-insta-flow. The raw data were not made publicly available due to privacy restrictions.

Further relevant information

This study was approved by the Research Ethics Committee of PUC Minas under the Certificate of Presentation for Ethical Appreciation (CAAE) number 93670925.6.0000.5137. The authors acknowledge the use of generative AI tools (ChatGPT) to support text revision and enhance clarity; all content was reviewed and validated by the authors. The authors also recognize the importance of promoting diversity and inclusivity in scientific writing. In preparing the reference list, we included works from authors of diverse backgrounds and genders, as well as from different geographical and academic contexts, aiming to reflect a broad and inclusive range of contributions to the field.

References

Alutaybi, A., Arden-Close, E., McAlaney, J., Stefanidis, A., Phalp, K., and Ali, R. (2019). How can social networks design trigger fear of missing out? In *2019 IEEE International Conference on Systems, Man and Cybernetics (SMC)*, pages 3758–3765. IEEE. DOI: https://doi.org/10.1109/SMC.2019.8914672.

Assessoria de Comunicação Social - ASCOM (2022). Celular segue como aparelho mais utilizado para acesso à internet no brasil. `https://www.gov.br/mcom/pt-br/noticias/2022/setembro/celular-segue-como-aparelho-mais-utilizado-para-acesso-a-internet-no-brasil`. Accessed on 10 December 2025.

Backlinko Team (2025). Instagram Statistics: Key Demographic and User Numbers. `https://backlinko.com/instagram-users`. Accessed on 10 December 2025.

Baughan, A., Zhang, M. R., Rao, R., Lukoff, K., Schaadhardt, A., Butler, L. D., and Hiniker, A. (2022). "I Don't Even Remember What I Read": How Design Influences Dissociation on Social Media. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery. DOI: https://doi.org/10.1145/3491102.3501899.

Baumer, E. P. S., Sun, R., and Schaedler, P. (2018). Departing and returning: Sense of agency as an organizing concept for understanding social media non/use transitions. *Proceedings of the ACM on Human-Computer Interaction*, 2(CSCW). DOI: https://doi.org/10.1145/3274292.

Carvalho, L. P., Suzano, J., Santoro, F., and Oliveira, J. (2022). A meta-scientific broad panorama of ethical aspects in the Brazilian IHC. *Journal on Interactive Systems*, 13:105–126. DOI: https://doi.org/10.5753/jis.2022.2579.

Cox, K. and Walker, D. (1993). *User Interface Design*. Prentice Hall, New York.

Csikszentmihalyi, M. (1999). *A Descoberta do Fluxo*. Rocco, Rio de Janeiro.

Cunha, A. and Aguiar, Y. (2020). Reflections on the role of nudges in human-computer interaction for behavior change: software designers as choice architects. In *Proceedings of the 19th Brazilian Symposium on Human Factors in Computing Systems*, pages 1–6. DOI: https://doi.org/10.1145/3424953.3426652.

Hu, E., Stavropoulos, V., Anderson, A., Clarke, M., Beard, C., Papapetrou, S., and Gomez, R. (2019). Assessing online flow across cultures: A two-fold measurement invariance study. *Frontiers in Psychology*, 10. DOI: https://doi.org/10.3389/fpsyg.2019.00407.

Huang, C. (2017). Time spent on social network sites and psychological well-being: A meta-analysis. *Cyberpsychology, Behavior, and Social Networking*, 20(6):346–354. DOI: https://doi.org/10.1089/cyber.2016.0758.

Kircaburun, K. and Griffiths, M. D. (2018). Instagram addiction and the big five of personality: The mediating role of self-liking. *Journal of Behavioral Addictions*, 7(1):158—-170. DOI: https://doi.org/10.1556/2006.7.2018.15.

Lukoff, K., Lyngs, U., Zade, H., Liao, J. V., Choi, J., Fan, K., Munson, S. A., and Hiniker, A. (2021). How the design of youtube influences user sense of agency. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems*. DOI: https://doi.org/10.1145/3411764.3445467.

Lyngs, U., Lukoff, K., Slovak, P., Seymour, W., Webb, H., Jirotka, M., Zhao, J., Van Kleek, M., and Shadbolt, N. (2020). 'I Just Want to Hack Myself to Not Get Distracted': Evaluating Design Interventions for Self-Control on Facebook. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. DOI: https://doi.org/10.1145/3313831.3376672.

McCarthy, J. and Wright, P. (2004). Technology as experience. *Interactions*, 11(5):42–43. DOI: https://doi.org/10.1145/1015530.1015549.

Mirsch, T., Lehrer, C., and Jung, R. (2017). Digital nudging: Altering user behavior in digital environments. In *Proceedings of the 13th International Conference on Wirtschaftsinformatik (WI) 2017*, pages 634–648. `https://api.semanticscholar.org/CorpusID:2409622`. Accessed on 10 December 2025.

Oberlo (2024). Instagram gender demographics (2024). `https://www.oberlo.com/statistics/instagram-gender-demographics`. Accessed on 10 December 2025.

Purohit, A. K., Barclay, L., and Holzer, A. (2020). Designing for Digital Detox: Making Social Media Less Addictive with Digital Nudges. In *Extended Abstracts of*

the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery. DOI: https://doi.org/10.1145/3334480.3382810.

Roberts, J. A. and David, M. E. (2023). Instagram and TikTok Flow States and Their Association with Psychological Well-Being. *Cyberpsychology, Behavior, and Social Networking*, 26(2):80–89. DOI: https://doi.org/10.1089/cyber.2022.0117.

Rosemberg, C., Boscarioli, C., Furtado, E., Silveira, M. S., Prates, R. O., Bim, S. A., and Barbosa, S. D. J. (2014). Formação em IHC e Mercado. In Baranauskas, M. C. C., Souza, C. S., and Pereira, R., editors, *I GranDIHC-BR — Grandes Desafios de Pesquisa em Interação Humano-Computador no Brasil*, pages 31–34. Sociedade Brasileira de Computação (SBC).

Santoro, F. M. and Costa, R. M. E. M. d. (2021). Towards ethics in information systems. *Journal on Interactive Systems*, 12(1):69—82. DOI: https://doi.org/10.5753/jis.2021.961.

Sholeh, A. and Rusdi, A. (2019). A New Measurement of Instagram Addiction: Psychometric Properties of The Instagram Addiction Scale (TIAS). In *Proceedings of the Conference of Indonesian Students Association in South Korea (CISAK)*, pages 91–97.

Sridevi, S. (2014). User Interface Design. *International Journal of Computer Science and Information Technology Research*, 2(2):415–426.

Stephanidis, C., Salvendy, G., Antona, M., Chen, J. Y. C., Dong, J., Duffy, V. G., Fang, X., Fidopiastis, C., Fragomeni, G., Fu, L. P., Guo, Y., Harris, D., Ioannou, A., Jeong, K.-a., Konomi, S., Krömker, H., Kurosu, M., Lewis, J. R., Marcus, A., Meiselwitz, G., Moallem, A., Mori, H., Nah, F. F.-H., Ntoa, S., Rau, P.-L. P., Schmorrow, D., Siau, K., Streitz, N., Wang, W., Yamamoto, S., Zaphiris, P., and Zhou, J. (2019). Seven HCI Grand Challenges. *International Journal of Human–Computer Interaction*, 35(14):1229–1269. DOI: https://doi.org/10.1080/10447318.2019.1619259.

Tran, J. A., Yang, K. S., Davis, K., and Hiniker, A. (2019). Modeling the Engagement-Disengagement Cycle of Compulsive Phone Use. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery. DOI: https://doi.org/10.1145/3290605.3300542.

Wood, L. E. (1997). *User Interface Design: Bridging the Gap from User Requirements to Design*. CRC Press, USA, 1st edition.

A Online Flow Questionnaire (adapted)

1. How often do you browse Instagram on your cell phone?
   ( ) Never or almost never
   ( ) Once a week
   ( ) Two or three times a week
   ( ) Every day, once a day quickly
   ( ) Every day, for 1 or 2 hours in total
   ( ) Every day for more than 2 hours

2. How often do you use Instagram from your computer?
   ( ) Never or almost never
   ( ) Once a week
   ( ) Two or three times a week
   ( ) Every day, once a day quickly
   ( ) Every day, for 1 or 2 hours in total
   ( ) Every day for more than 2 hours

3. How often did you use Instagram on your computer in the past week?
   ( ) Never or almost never
   ( ) Once a week
   ( ) Two or three times a week
   ( ) Every day, once a day quickly
   ( ) Every day, for 1 or 2 hours in total
   ( ) Every day for more than 2 hours

4. (FLOW-1) My mind isn't wandering. I'm not thinking about anything else. I'm totally involved in what I'm doing. My body feels good. I don't seem to hear anything. The world seems to be cut off from me. I'm less aware of myself and my problems. My concentration is like breathing. I never think about it. I actually become quite unaware of my surroundings once I've really started. When I start, I really shut out the whole world. As soon as I stop, I can let it back in. I'm so involved in what I'm doing. I can't see myself separate from what I'm doing. Have you come across any of the above situations when using Instagram this past week?
   ( ) Yes ( ) No

5. (FLOW-2) When using Instagram on your computer this past week, did you get the feeling that time was passing faster than usual?
   ( ) Yes ( ) No

6. (FLOW-3) When using Instagram on your computer this past week, did you feel a sense of pleasure?
   ( ) Yes ( ) No

7. (FLOW-4) When using Instagram on your computer this past week, did you feel a "positive challenge"?
   ( ) Yes ( ) No

8. (FLOW-5) When using Instagram on your computer this past week, did you have the feeling of "being controlled by something"?
   ( ) Yes ( ) No