Scrolling, Scrolling and Scrolling: A discussion about Infinite Scrolling in major Social Media platforms

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Abstract

The use of social media (SM) has reached unprecedented levels, with around 58.4% of the global population actively engaging with these platforms. This widespread use has brought attention to problematic social media use (PSMU), characterized by excessive engagement leading to negative consequences like depression, anxiety, and stress. A key feature contributing to PSMU is Infinite Scrolling (IS), an interface design that infinitely loads content, driven by sophisticated AI algorithms. This article explores IS within major social media platforms such as TikTok, YouTube, Instagram, and others. It examines how IS, coupled with recommendation systems and social investment mechanisms, enhances user engagement, consequently boosting revenue through targeted advertising and data monetization. We discuss how these platforms exploit psychological vulnerabilities alongside the significant role of AI. Possible solutions include app and device-level time limits, intra-app modifications, and the implementation of digital well-being features. However, the most effective approach may lie in the development of regulatory measures to enforce responsible design practices to allow user-modifications to these applications. This article emphasizes the need for application design regulation laws to create a healthier digital environment.

Keywords— Computer Ethics, Social Media, Problematic Social Media Use (PSMU), Infinite Scrolling (IS), User Engagement, Addictive Design, Recommendation Systems, Digital Well-being, Digital Regulation Laws

1 Introduction

It is estimated that around 58.4 % of the total world population use social media, which is 93.4% of all internet users. With the rapid development of social media (SM), problematic social media use (PSMU) has attracted increasing attention [27]. According to a recent meta-analysis, the global prevalence of PSMU in social media

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users is 17.42% [22, 27]. Although there is no universally accepted definition of PSMU, most researchers recognize it as excessive use of social networks, which leads to negative consequences. Almost half of social media users were at high risk for PSMU, who were more prone to depression, anxiety, and stress [27].

[25] mentions several addictive software designs, including infinite scrolling (IS), and explains how it is correlated with the "Bottomless Bowl" concept of psychology, which tricks users into consuming more content. There are several dark attention capture patterns explained by [24], three of them are recommendation systems, social investment mechanisms, and infinite scrolling.

1.1 What is Infinite Scrolling?

Infinite scrolling (IS), a feature designed to keep users engaged by continuously loading content as they scroll, has become a common user interface pattern on social media platforms, news websites, and other content-driven applications. This feature, driven by AI algorithms, aims to maximize user engagement, but has raised concerns about its impact on mental health and productivity [38]. We have decided to analyze this feature in this article as a case study of addictive software design in the major SM, as it is an important part and is present in almost all of them. In fact, in some apps like TikTok, it is the main feature.

IS, traditionally, involves the constant and continuous delivery of content as the user browses, usually by scrolling down the page [16]. However, in the context of major social media platforms, it is usually powered by a recommender system and some form of social investment that we will analyze later. To make it more clear, for example, consider the For you page in TikTok or Instagram Reels, they provide an unlimited number of videos. By scrolling up, the users would be led by the application to see the next video. The next video is chosen based on the calculation of individual user's preferences so that the application can make sure that users would keep focused on the provided content. First-time users may not be interested right away, but as users continue to watch videos, the algorithm of short video applications can analyze more about them [39]. Additionally, users can interact with the content by liking, commenting, etc., which is a form of social investment. By default, throughout the article, when we mention IS, we implicitly also refer to the Recommendation System, and the Social Investment behind it, too.

1.2 Adoption of IS

- **TikTok**: TikTok is heavily reliant on IS within its main feed, known as the "For You" page, and the "Following" page. Users can swipe up to view a continuous stream of short-form videos personalized to their interests and engagement patterns. *TikTok has used IS since its launch.*
- **YouTube**: On YouTube, IS is implemented on the homepage, search results, as well as YouTube Shorts. As users scroll down, more videos are continuously loaded, allowing them to browse through an infinite list of video recommendations without needing to click through to the next page. *YouTube initially used pagination but adapted to IS.*
- **Instagram**: Instagram employs IS in the user's feed, Explore page, and Reels section. As users scroll, new content is dynamically loaded, providing a continuous stream of content from accounts they follow and suggested content based

on their interests. *Instagram has used IS since its inception by the classical UX definition instead of pagination, and it was not the main feature of the app. Eventually, Instagram revealed the Reels on August 5, 2020. The Instagram Reels is also mostly identical to the Douyin/TikTok up-scrolling strategy. Instagram used to be a social media application focusing on the publication of pictures, but Instagram Reels could be changing the picture. In 2022, Instagram updated Instagram Reels and decided to make it the main feature of the application.[39]*

- **Facebook**: Facebook uses IS mainly on the News Feed and some other parts of the app. Users can scroll indefinitely to view more posts, updates, and comments from their friends, groups they belong to, and suggested content based on their interests. *Facebook initially used pagination but transitioned to IS.*
- **Pinterest**: Pinterest employs IS on its main feed and within specific boards and search results. As users scroll, more pins (images, videos, and articles) are loaded, allowing for a seamless browsing experience of ideas and inspiration. *Pinterest initially used pagination but quickly adopted IS.*
- **Twitter (X)**: Twitter (now rebranded as X) utilizes IS on its main timeline and in search results. Users can continue scrolling to see more tweets, replies, and trends. *Twitter initially used pagination but later transitioned to IS.*

2 Market and Revenue Models

In this section, we take a brief look at some financial aspects of the major SM platforms. In the next section, we will argue why the use of IS is very profitable for these companies based on their revenue models.

2.1 Market Analysis and Growth

The Business Research Company's Global Social Media Market Report 2024 states that the social media market will grow from $219.06 billion in 2023 to $251.45 billion in 2024 at a CAGR of 14.8%. It is also predicted that it will reach $413.16 billion by 2028 [31]. So far, social media platforms have seen substantial growth in their revenue as evident in Figure 1. It is important to realize that many of these platforms share design features to maximize metrics like user engagement.

2.2 SM Revenue through data monetization

Social media platforms have developed robust revenue models by advertising and, more generally, data monetization. In the online context and on mainstream social media platforms specifically, how and to whom advertisements are presented is different as compared to advertisement-based models on television or the printed press. This transition is related to the availability of massive amounts of data about each user and targeted advertising [33]. In contrast to offline settings, online settings offer more data points per user (the advertising audience). These data include data from user profiles such as sociodemographic variables, content 'liked', browser history, GPS location and movement data from the smartphone, and sound recordings from the smartphone's microphone [21, 33]. These methods are very popular amongst large companies such as Facebook, which provide free access to their social media platforms and services in exchange for user data. A key concern is that organizations or individuals may not

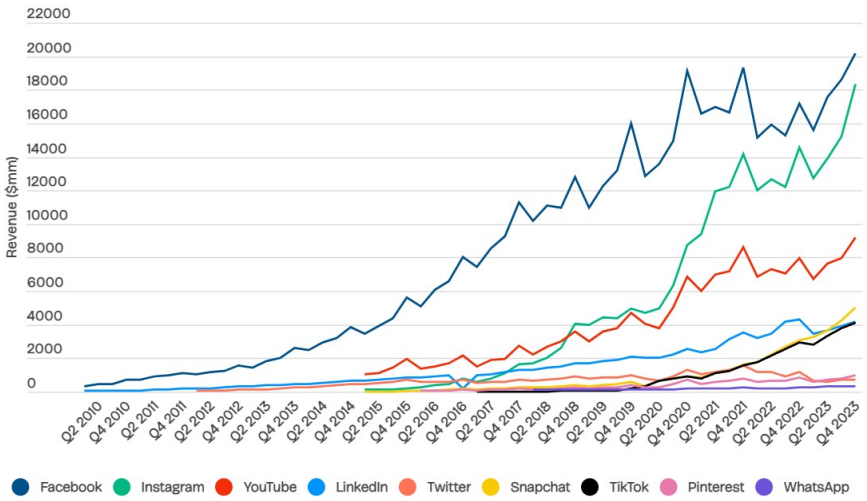

Figure 1: App Revenue by application [7]

recognize the true value of the information they are giving up. Although it is not the focus of this article, it is worth mentioning the importance of data regulations to protect users.

The significance of this revenue model is further underlined by profits. Alphabet was ranked the third most profitable, while Meta platforms were ranked the sixth most profitable companies (based on profits rather than revenue) in 2022, according to the Fortune 500 list (Fortune Media IP Limited, 2022) [33]. There are many risks and benefits with this revenue model; some of which are discussed in [33].

2.2.1 Advertising

The primary source of revenue for social media platforms is targeted advertising. This is evident across major platforms like Meta (formerly Facebook), Twitter (now X Corp.), and LinkedIn. Meta posted net income of $39 billion on revenue of $134.9 billion for the fiscal year (FY) 2023 ending December 31, 2023. Approximately 99% of the year's total revenue was advertising revenue. The remaining revenue contributors were the company's Virtual Reality Labs segment and other sources [12]. This revenue model is crucial, as it leverages the large user base of these platforms to attract advertisers who pay to display ads to users [13]. Social media companies also explore additional revenue streams, but advertising remains the dominant source [9]. Companies like Meta heavily monetize user data by offering highly targeted advertising solutions based on detailed user profiles, which include demographic information, interests, and online behavior. This approach allows advertisers to reach their desired audience more effectively, thus driving higher ad revenues. It is obvious that the more users use the app, the more ads they see, and the platforms collect more data about them, and they can show them better targeted ads.

2.2.2 Data brokering

Social media platforms also monetize user data by selling anonymized data to third parties, providing analytics services, and improving their ad targeting algorithms. The sale of user data and analytics services allows these platforms to offer more value to advertisers, thus justifying higher advertising rates. [33] states that social media platforms mainly show advertisements on their platform in exchange for free services they provide, but does not consider that within large companies the data are used for many other different purposes. This further emphasizes the importance of protecting user privacy and data regulation. Similarly, in this case, too, SM companies compete to increase their user engagement.

2.3 The new cool kid in town: TikTok

Average revenue per user (ARPU) is one of the most important metrics for large social media companies like Facebook, Twitter, and TikTok. The ARPU is how much revenue a company makes per user and is an important evaluation of how successful a business is, especially with how much movement there is when it comes to the top social media sites [14]. TikTok shines particularly when considering this metric. For example, as we can see in Figure 3 Meta's ARPU for 2022 is 39.63$, while for the same year TikTok reached $65.8. TikTok's ARPU is grown substantially since 2020, when it was $11.66. In 2024, the ARPU is projected to reach almost $113 [37].

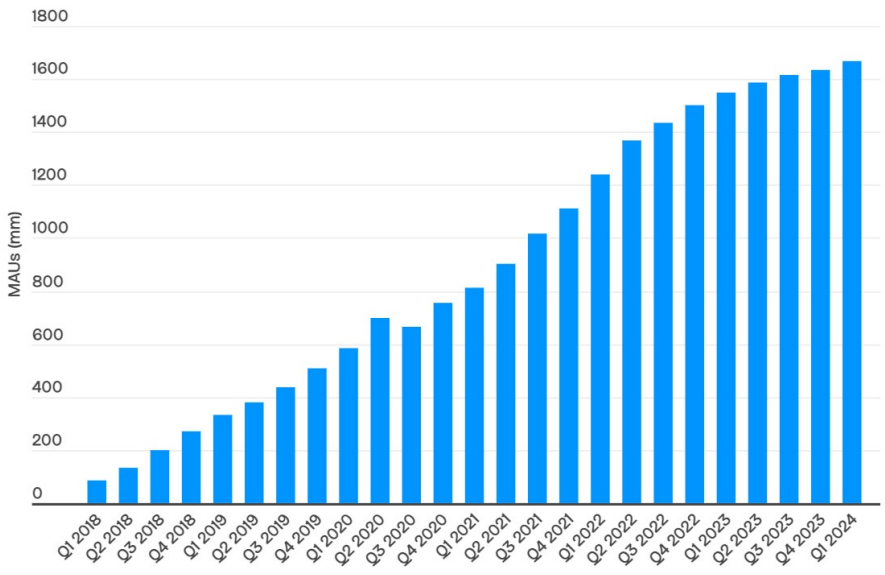

Figure 2: TikTok Users [7]

The core ability of TikTok is the powerful algorithm that recommends content for users based on their prior choices such as likes, shares, or location. [19] In my opinion, by taking into consideration the ARPU values, and looking at 2 itself is enough to realize the profitability of this feature. Of course, there are many other factors including

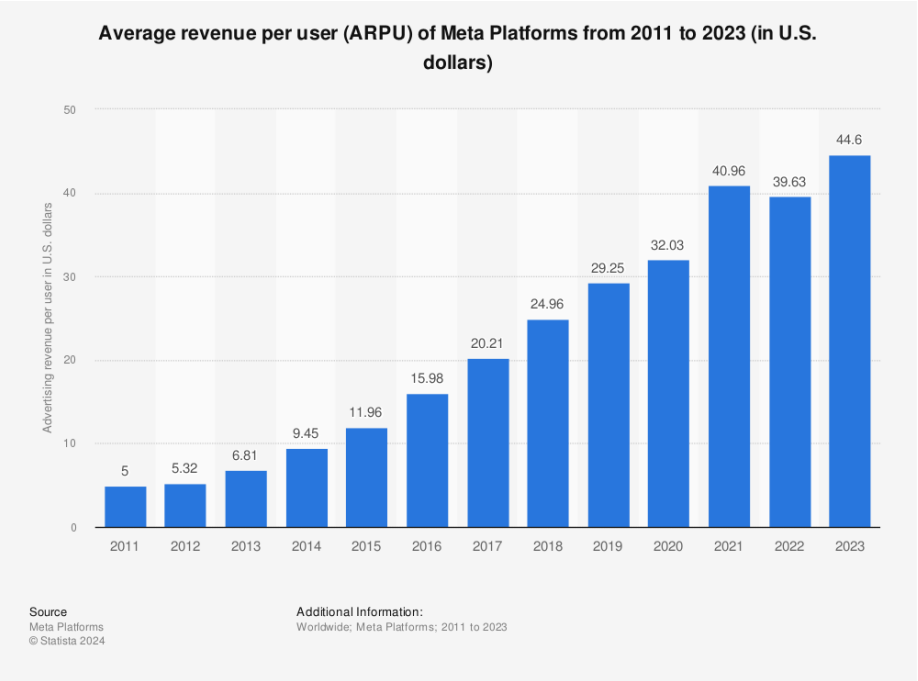

Figure 3: Meta ARPU [35]

marketing, management, COVID-19, etc., but still IS plays a major role.

In summary, i) a large user base plus ii) the availability of vast amounts of data, in addition to iii) the capability of presenting differentiated, personalized advertising content to individual users offer mainstream social media companies extensive opportunities to generate revenue and profit through user-related targeted advertising [33].

3 User Engagement

In this section, we briefly analyze how SM platforms use IS to increase their user engagement.

3.1 Why?

Social media platforms compete by offering value to their installed base of users [15]. The literature has conceptualized the platform value as comprising two dimensions [3, 4]. The first dimension is the total content quantity, which is the overall volume of content generated. The second is user engagement, which is realted to the meaningfulness and desirability of the content [15], relating to the quality dimension [4]. Engaging content retains users by creating a lock-in effect for them, that is, users will not go to other platforms for content or information [8]. A key method method is the

use of sophisticated AI algorithms to show engaging personalized content.
After studying the main revenue model these platforms use, it should be evident that maximizing the number of users and their engagement in the application is crucial to the success of these businesses.

3.2 How?

In the contemporary attention economy, tech companies adopt mechanisms that exploit users' psychological vulnerabilities to grab users' attention [24] and maximize the time spent by people on their digital platforms [24]. We already touched upon this in the introduction section. Let us delve deeper.

3.2.1 Taking advantage of Psychological vulnerabilities

There are many aspects and views around this topic in the literature. The "Bottomless Bowl" concept from psychology illustrates how users are tricked into consuming more content [25]. This basically means that since there is no stop or end to scrolling, one can easily consume past the assumed point of consumption without knowing [39]. This results in users spending much more time on applications than intended [25].

We can also see IS as a gambling machine. Like pulling the lever of a slot machine, scrolling down the feed can result in perceiving content we enjoy and feel rewarded by or do not. [26] argue that this non predictable pattern of reward can be considered partial reinforcement, which is often seen in the context of compulsive use.

There are also some research that mention the presence of dark attention-capture patterns in SM platforms. A dark attention-capture pattern is defined as: a design or a system functionality that exploits people's psychological vulnerabilities to maximize time spent, daily visits, and/or interactions on a digital service against the person's will [24]. Attention-capture dark patterns, in particular, have the following characteristics:

- they distract from a goal that a person has in a specific moment, thus undermining the individual's autonomy [20]
- they make a person experience a lost sense of time and control [17]
- they make a person experience a sense of regret in hindsight about the time spent on the service [5]

[24] mentions 5 major dark attention-capture patterns in SM platforms including Recommender Systems and Social Investment Mechanisms. When we talk about Infinite Scrolling, in almost all of the SM platforms, it comes alongside these two. Social metrics such as number of reactions, comments, followers, and views can 'bind' users to the underlying platform, giving rise to an attention-capture dark pattern that we called **Social Investment**. Such a mechanism influences users by instilling the idea that they should continue to use the platform to avoid loosing the achieved progresses. Furthermore, despite reactions and comments can be considered as one of the building block of contemporary social networks, researchers highlight that they are sometimes designed "to structure rewards in a way that is likely to encourage use" [26], e.g., Receiving likes and comments, moreover, can also be seen as a partial reinforcement process, as only some (non predictable) interactions are rewarded.

3.2.2 The role of the AI

As we already mentioned, the heart of these systems is the recommendation system that provides this endless stream of content. The AI algorithm of TikTok will deter-

mine video recommendations based on learning users' preferences and usages of the app, which is a unique advantage [19]. **Recommender Systems** are undoubtedly a tool that can improve the overall user's experience with a service that is designed to maximise a user's utility [2]. However, when there are misalignments between the goals of the platform and any of the user's utility, e.g., in terms of digital wellbeing, recommendations can easily become an instrument to trap the user into the system, especially when suggestions are endlessly delivered during the current user's interaction [17]: as the YouTube's product chief said at a recent Consumer Electronics Show (CES), more than 70% of YouTube watchtime is driven by artificial intelligence and recommendations [6]. The AI-based algorithm of TikTok determines users' tailored information distributions based on analyzing the content of each video and watching the preference of users to perform an endless and highly attractive video stream. More specifically, TikTok performs real-time traffic distribution based on the analysis of the users' hashtags, personas, and feedback data that include views, engagement (like, comment, share, etc.), and audience breakdown (market segmentation, ages, genders, devices, etc.).

The individualized recommendation of TikTok also neurologically affects its addiction as the recommender algorithm is able to discover contents to up-regulate the activity of a set of DMN (default mode network) subregions and VTA(ventral tegmental area) to reinforce video viewing behavior [36]. VTA is the origin of the dopaminergic cell bodies of the dopamine system, which makes it largely connected to the reward circuitry of the human brain. Specifically, the study by [36] showed that personalized videos displayed due to the algorithm, triggered stronger DMN and VTA activities than generalized videos, and the more personalized the videos, the higher level of activation presents. Taking the nature of TikTok into consideration as well, for every 15 seconds of continuous stimulations of short videos, the algorithm stimulates dopamine release constantly by providing new and captivating content, which supersedes other video companies both in the nature of video form (the length) and the algorithm not disclosed that tailor highly personalized content. In simple terms, the top-notch algorithm offers what users like incessantly and causes addiction, in turn, by constantly stimulating users' reward circuitry to an extent that they cannot let TikTok go easily. In this sense, when playing TikTok, users' need for more short videos has the same mechanism as drug addicts' need for more drugs, and the algorithm amplifies this addiction by constantly recommending videos [28].

3.3 Impacts on people lives

We cannot ignore the benefits and the positive impact of these major SM platforms on people's live everywhere. However, there are dozens of research about the effects of SM platforms on their users, and getting deep into this topic is out of the scope of this article.

In a study done by [1], where they tested a custom version of tweeter called "Chirp", the participants said they regularly had moments where they 'lost track of time' (P30), became 'all consumed' (P28) and stopped paying attention to the world around them. Social media may be a particularly attractive avenue for escape from the burden of volition due to various aspects of its design that are intended to keep users 'hooked' on the experience [1].

Social media causes procrastination and is a frequent source of self-control struggles [18]. Many people procrastinate through their use of social media [30], because procrastination can provide a short-term mood boost [34]. This creates a spoiled pleasure

effect and is attributable to the negative self-evaluation and guilt that follows when people snap back to reality and realize that their original goals remain unaccomplished [11].

4 Possible Solutions

4.1 App, and device level limits

The first solution that we might think of would be to set time limits on certain applications or the device in general (Digital Intervention tools). In fact, the majority of the drawbacks of social media may be addressed by limiting how much time is spent on social networking sites [29].

However, as a computer in our hands, a smartphone and its applications (apps) offer a wide array of features. User engagement is an important metric for evaluating products, and thus, app providers often take the strategy to deliver multiple features in a single 'super app' rather than segregating each into a single-purpose app. As a result, an app often has a mix of utilitarian and hedonistic features that are tightly intertwined [5]. In our case, social media apps offer a mix of quasi-essential and addictive features in an app (e.g., Instagram has following feeds, recommended feeds, stories, and direct messaging features), which makes it hard to apply uniform logic for all uses of an app without a nuanced understanding of feature-level usage behaviors [5]. In fact, this is one of the ways that SM draws users into their apps, takes them on a 'feature tour', essentially trapping them in the application to increase the time spent on their platform [32, 5].

In a study, participants mentioned 29 features they regret spending too much time on. People mostly regret spending time on the 'Entertainment' (34%) features on Facebook, followed by the 'News Feed' feature (24%) [23]. Therefore, we cannot treat different features of an application in the same way, and this method is not very practical.

4.2 Intra-app Modifications and Interventions

A promising (and hopefully more efficient) alternative to timers and lockout mechanisms is to focus on the internal mechanisms adopted by digital services that are likely to contribute to excessive technology usage and problematic behaviors [17].

Hiding 'social' metrics, e.g. views and number of likes, or, more drastically, removing all comments and reactions, significantly decreased the number of daily access to the service. Furthermore, it led participants to slightly decrease daily use and passive sessions, for example, with less scrolling, and significantly decreased the users' perception on Facebook intensity use [24].

In some studies, design researchers have explored removing the newsfeed from Facebook [18], removing YouTube auto-play [17] and adapting the platform to a plan already set by the users' parent [10]. These design interventions have found success in increasing users' sense of control and satisfaction when using social media. Both goal reminders and removed newsfeed helped participants stay on task and avoid distraction [18].

There is a need for a digital well-being design agenda that promotes users' sense of agency through tailored internal supports, which target specific user scenarios and

features of the experience [40]. A primary challenge in this context is the implementation of intervention apps and user-controlled modifications within the application. As we mentioned, intervention apps are third-party applications designed to monitor and regulate user activity across various social media platforms. These apps can provide insights, set usage limits, and offer recommendations to promote healthier usage patterns. However, major social media companies often resist sharing information or allowing such external modifications to their applications, which hinders the effectiveness of these interventions.

Additionally, user-controlled modifications involve built-in features within the social media applications themselves that allow users to customize and control their experience. Examples include options to disable Infinite Scrolling, limit notifications, or set time restrictions on app usage. Although some platforms have started to offer such features, they are limited, and their effectiveness depends on how easy they are to use if they are available at all.

5 Conclusion: Need for Application Regulation Laws

The rapid growth of social media platforms and their sophisticated use of Infinite Scrolling (IS) have raised significant concerns about user well-being. In my opinion, one critical solution is the legislation of application regulation laws to mitigate the negative effects associated with excessive use. Regulatory measures can help ensure that platforms adopt responsible design practices that prioritize user health and safety.

Since major social media platforms are unlikely to share information or allow modifications to their applications through third-party apps, the most feasible solution would be to focus on developing laws and regulations to create a standard framework of user-controlled modifications for these apps. These built-in features within the applications would allow users to customize and control their experience, for example, to disable some features that cause compulsive use.

A standard framework designed by experts and researchers based on scientific studies that takes into consideration both sides' rights can foster a healthier digital environment. By balancing the benefits of social media with the necessary protections for user well-being, regulatory measures can help mitigate the potential harms of excessive social media use. This method unlike application and device level limits, still gives the users the ability to use other essential features, and doesn not require the companies to share their data with third parties. These types of laws are already proven to be somewhat effective. For example, General Data Protection Regulation (GDPR) by EU to how personal data is collected, processed, and stored, giving individuals greater control over their personal information and imposing strict obligations on organizations handling such data. Or the current framework (Artificial Intelligence Act) that still is being developed by the EU to regulate negative impacts of AI.

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