

Investigating the Impact of Short Video Fragmented Information on Adolescent Cognitive Load and Behavioral Patterns

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Abstract. This study examines the impact of fragmented short video content on adolescents' cognitive load and behavioral patterns within the context of the widespread proliferation of short video platforms and algorithm-driven information dissemination in the new media era, which profoundly influences youth cognitive development. Using a literature review methodology, this study systematically examines the technical mechanisms of recommendation algorithms and their relation to cognitive load theory. From an interdisciplinary perspective, it analyzes how algorithm-driven content delivery contributes to the formation of information cocoons and the associated cognitive consequences. Research findings indicate that the high-frequency, highly stimulating fragmented information streams characteristic of short videos significantly elevate extraneous cognitive load among adolescents. This increase results in attentional fragmentation, superficial thinking, diminished delay of gratification, and a tendency to avoid complex cognitive tasks. The conclusion indicates that the algorithm-driven information dissemination model fundamentally conflicts with adolescents' developmental needs for constructing a systematic knowledge framework. Addressing this requires a multidimensional intervention approach, including algorithm optimization, media literacy education, and the design of conducive learning environments, to foster healthy cognitive and behavioral development among youth.

Keywords: Short videos, adolescent development, cognitive load theory, recommendation algorithms.

1. Introduction

In recent years, the proliferation of mobile internet and the iterative advancement of smart terminal devices have facilitated the rapid development of short video platforms. Domestic platforms such as Douyin, Kuaishou, and Bilibili, along with international counterparts like TikTok and Instagram, have become integral components of media consumption among the adolescent demographic. The 49th Statistical Report on the Development of Internet in China indicates that as of December 2021, the average weekly online duration for Chinese internet users reached 28.5 hours, representing an

increase of 2.3 hours compared to December 2020. Additionally, the short video user base totaled 934 million, with a penetration rate of 90.5%. Public data indicates that TikTok's daily active user base exceeds 600 million, establishing it as China's most popular short-video platform [1]. The platform presents users with brief video content ranging from as short as fifteen seconds to several minutes, satisfying the demand for rapid and highly stimulating information intake. This modality subtly influences and potentially alters adolescents' cognitive processes and behavioral patterns.

The highly fragmented nature of information is a prominent characteristic of short-form videos. Compared to traditional media such as print, film, and documentaries, short videos typically present themselves with high visual impact, a weak narrative structure, and rapid information acquisition. This mode of fragmented information dissemination not only diminishes users' ability to acquire a comprehensive knowledge system but also poses challenges to adolescents' attention span, deep thinking capabilities, and information integration skills, thereby impacting their cognitive structures and behavioral patterns. Short videos, characterized by highly fragmented information, rely on personalized recommendation algorithms that utilize real-time monitoring and modeling of user search behavior, video completion rates, likes, and favorites. This approach enables a "tailored" content delivery, effectively achieving individualized content curation. This mechanism significantly enhances content engagement and user retention, while covertly exacerbating information dependency and behavioral rigidity among adolescents.

In this context, this paper endeavors to examine, from the perspective of Cognitive Load Theory, how adolescents are influenced by the conflict between intrinsic cognitive resource limitations and the extraneous complexity of information during prolonged exposure to short-form video content. Meanwhile, this paper will integrate recommendation algorithm mechanisms, focusing on how they continuously shape and modify users' viewing habits through data analysis and processing, thereby influencing their behavioral patterns, cognitive approaches, and value judgments.

This study focuses on the era characterized by the rapid development of mobile internet and big data models; it holds significant implications for the optimization of short video recommendation algorithms and online education for adolescents. This study primarily explores two aspects: short video recommendation algorithms and adolescent information overload. Utilizing literature review methodology to search and analyze relevant data and publications, this approach effectively elucidates the underlying mechanisms of recommendation algorithms and the challenges faced by adolescents amid information overload, thereby facilitating comprehensive research. The ultimate aim of this study is to provide a theoretical framework and practical insights for future research on adolescent media literacy education, platform algorithms, and environmental information optimization through a comprehensive literature review and theoretical integration, adopting an interdisciplinary perspective that combines cognitive psychology and technological mechanisms. This paper aims to examine how the fragmented nature of short videos and the mechanisms of recommendation algorithms jointly influence adolescents' cognitive load management and behavioral patterns.

2. Literature review

Arvind Narayanan elucidates the concepts of three distinct algorithmic paradigms—subscription model, network model, and recommendation model—in his article "Understanding Social Media Recommendation Algorithms," providing an analytical overview of their historical evolution within the domain of computational social science [2]. Narayanan discusses the varying levels of dissemination of two distinct tweets on Twitter, thereby introducing the concept of structural virality as proposed by Sharad Goel et al. in their paper "The Structural Virality of Online Diffusion [3]." In

the article "Do Not Recommend? Reduction as a Form of Content Moderation," Tarleton Gillespie introduces the concept of shadowbanning. Unlike traditional content moderation techniques, shadowbanning involves not removing problematic content outright; instead, it diminishes the visibility of such content in user recommendations without deleting it from the platform [4].

The scholars' understanding and analysis of the underlying logic of recommendation algorithms are already highly thorough; however, their discussion on the impact of these algorithms on users remains insufficiently comprehensive. This paper examines how recommendation algorithm mechanisms influence user experience among specific demographic groups, using short videos as a case study. From a technical perspective of recommendation algorithms, it explores the challenges posed by fragmented information to adolescent development, thereby addressing existing research gaps in this domain.

Cognitive Load Theory (CLT) is a cognitive framework grounded in human architecture, with a primary assumption that human working memory has a limited capacity. This concept was first proposed by cognitive psychologist John Sweller of the University of New South Wales, Australia, in 1988, building upon early research by Miller and colleagues. During the learning process, humans allocate the majority of their cognitive resources to this activity, which in many cases results in an overload of instructional formats [5]. In Geary's "An Evolutionarily Informed Education Science," the classification of knowledge incorporates primary biological knowledge and secondary biological knowledge [6].

In the article "Managing Cognitive Load—Recent Trends in Cognitive Load Theory," Maria Bannert identifies three primary sources of cognitive load: 1. Intrinsic Cognitive Load (ICL), which is related to the inherent complexity of the material to be learned; 2. Extraneous Cognitive Load (ECL), originating from poorly designed instructional materials; 3. Germane Cognitive Load (GCL), which occurs when available working memory capacity is allocated to the deeper construction and automation of schemas. Emerging technologies, such as animations, narration, and prompts, can provide novel presentation formats that enhance learning outcomes [7]. Meanwhile, Maria Bannert integrates Geary's taxonomy of knowledge with Sweller's Cognitive Load Theory to elaborate on the evolving trends of cognitive load theory within the field of psychology.

The existing theoretical frameworks are sufficiently comprehensive; however, the interdisciplinary application of cognitive load theory within media communication remains underdeveloped. Emerging media offer diverse pedagogical approaches, yet, in most instances, the learning environment facilitated by the internet is notably chaotic. Scholars may incur unnecessary burdens due to technological innovations or suboptimal design. This paper will approach the topic from an interdisciplinary perspective, analyzing from a psychological standpoint the negative impacts that short-form videos and similar fragmented information have on adolescents.

3. The challenges posed by fragmented short-video content to adolescent development

Harvard University professor Keith S. Sanderson posits in his 2006 publication, "Infotopia: How Many Minds Produce Knowledge," that individuals are either unable or unwilling to access all information available within social networks [8]. In the current era, information acquisition is inherently incomplete; consequently, individuals tend to selectively seek and accept information that is useful or of personal interest, often neglecting content from other domains. Short video platforms have ingeniously exploited this phenomenon by developing recommendation algorithms that serve as the fundamental logic for short video content, thereby delivering personalized experiences to users. These algorithms generate social media feeds that permeate various aspects of daily life, such as the sidebar recommendations on YouTube, the daily product suggestions beneath Taobao's search

bar, and the streamlined video interface on TikTok [2]. Compared to traditional search methods, recommendation systems generate significantly higher and increasingly substantial user engagement. More importantly, platforms possess near-complete control over the content they recommend to users, whereas search results are constrained by the specificity of search queries.

Certainly, the mechanism of algorithms was not inherently perfected at their inception, nor did this concept emerge solely with the advent of the digital age. The evolution of social media algorithms can be delineated into three distinct phases: the subscription model, the network model, and the recommendation model. In early Chinese society, prior to the widespread adoption of television, reading newspapers was the primary means for households to stay informed about current political developments. People subscribed to newspapers through press agencies, with dedicated distributors delivering the papers daily. This system represents the earliest form of algorithmic modeling—what we now refer to as the subscription model. Its mode of dissemination primarily involves propagation from a single node to multiple nodes. When subscribing to a content creator's account on social media, users receive notifications upon the publication of new posts. The network model represents a refinement and deepening of the subscription model. When a user opts to further disseminate content—such as by sharing it, which is recorded on their personal account—the model triggers a cascade effect within the network, exposing the content to a broader audience. Subsequent viewers may then share the content, facilitating multi-level dissemination. The recommendation model posits that the greater the similarity between a user's interests and those of the content creator, the higher the likelihood that the user will be recommended the post.

Canadian communication scholar Marshall McLuhan, in his work "The Medium is the Message: An Inventory of Effects," articulates that the intrinsic nature of the medium itself and the societal transformations prompted by its evolution constitute the truly valuable messages, rather than the content transmitted through the medium [9]. McLuhan defines media in his work as artificial sensory extension systems of human faculties—such as language, print, and electronic media—highlighting their formal characteristics' fundamental influence on the modes of information presentation and reception. Today's adolescents access information through increasingly diverse and multifaceted channels. The dual nature of digital media is gradually becoming evident; the proliferation of trivial memes online essentially represents the deconstruction of complete information or events. These fragments are then reconstructed and disseminated via media formats that are easily digestible, such as short, catchy animations or music, facilitating rapid acceptance and spread. During this period, adolescents are in a rebellious phase. They unconsciously receive such information and, through online interactions and real-life experiences, seek validation and a sense of belonging. This results in the structured dissemination of these messages within digital and social networks. Attention within a limited time frame is finite; therefore, only a certain amount of content can generate this phenomenon at any given moment. The competition among these contents is intense, which is associated with the Cognitive Load Theory discussed later. This competitive environment drives content creators to continually pursue more eye-catching formats, thereby exacerbating information fragmentation. While adolescents seek novelty, they are also easily engulfed by this fragmented information, hindering the development of systematic cognition and deep critical thinking. Consequently, their information acquisition becomes superficial, which adversely affects cognitive development.

On the other hand, the processes of downgrading, reducing, or suppressing within recommendation algorithms are commonly referred to as shadowbanning; in the context of Chinese internet platforms, this practice is known as traffic limiting. It is a form of "soft" content moderation technique, wherein content deemed problematic is selectively displayed to a limited subset of users,

without being removed from the platform [4]. For instance, Facebook demotes posts by ranking them lower in users' feeds than their original placement, under the premise that users are less likely to encounter and further disseminate such content. A seemingly minor platform intervention can thus significantly impact content visibility. As adolescents' engagement with positive content on short-video platforms diminishes, these materials are increasingly deprioritized by recommendation algorithms. Since the core logic of these algorithms is based on engagement metrics, this leads to a further reduction in audience reach, resulting in adolescents receiving more fragmented and biased information.

In summary, while current personalized recommendation algorithms are efficient and engaging, they fundamentally alter the information environment for users, particularly adolescents. These algorithms reinforce what Sunstein describes as "information cocoons," and through mechanisms such as content fragmentation, viral dissemination, and covert manipulation techniques like shadowbanning, they may lead adolescents into narrowed information exposure and superficial thinking. This poses significant challenges to their cognitive development and comprehensive information acquisition. The platform's extensive control over information flow, coupled with the algorithmic tendency toward "degradation," is central to this issue.

4. Interdisciplinary applications of cognitive load theory in the context of the short video era

Currently, adolescents' access to information is covertly influenced by recommendation algorithm mechanisms and the intense, fragmented output driven by creator competition, characterized by weak structural coherence. This results in a substantial external cognitive load, impeding their ability to construct a comprehensive and coherent knowledge framework during information acquisition. Throughout the evolution of algorithms, in terms of subscription and network models, the extraneous cognitive load imposed on adolescents is comparatively lower than that of recommendation systems, owing to the constraints imposed by their modes of information dissemination. For instance, TikTok's "endless scrolling" feature results in a greater cognitive burden than Weibo's nested "information plus comments" structure. From the perspective of intrinsic cognitive load, the construction of adolescents' knowledge systems entails a dual requirement: firstly, establishing a solid core knowledge framework to serve as a foundational support; secondly, facilitating iterative updates and structural optimization of knowledge content through continuous learning. As previously mentioned, intrinsic cognitive load is related to the nature of the learning material. Fragmented information acquisition hampers the construction of a solid foundational framework and makes subsequent iterative updates of knowledge susceptible to bias. This has significant implications for adolescents, who are in a critical developmental period of their thinking styles and behavioral patterns.

In repeated cycles of video refreshes, adolescent users inadvertently become immersed in the virtual space created by short videos, rendering them unable to extricate themselves. Virtual media imagery can facilitate the public's forgetfulness of real-world difficulties and threats, allowing a temporary detachment from everyday life; in this context, visual landscapes serve as a refuge for the masses [10]. This will result in three negative effects: firstly, the algorithm-driven proliferation of massive, discontinuous fragments of information compels adolescent brains to frequently switch between tasks at a high cognitive load. This persistent interference significantly elevates extraneous cognitive load, eroding deep focus and fostering a habitual reliance on superficial "scanning" reading strategies. Consequently, adolescents find it challenging to sustain complex, coherent thought processes. Prolonged exposure to such information leads to neural overload and attentional fragmentation, impairing cognitive development. Under the former conditions, adolescents tend to

select algorithmically recommended, effortlessly digestible viewpoints or conclusions—such as short-video summaries or emotionally charged headlines—in their recreational activities to reduce cognitive load and achieve relaxation. This suppresses critical scrutiny and proactive information integration capabilities, fostering cognitive inertia and diminishing the willingness for independent analysis and logical reasoning. Over time, this leads to a trap of superficial information processing and intellectual stagnation, a cognitive pattern that conflicts with the developmental needs of adolescent learning. This cognitive framework tends to project onto behavioral patterns, leading to a degradation of delayed gratification and a trap of immediate satisfaction. Algorithmically targeted delivery of "instant gratification stimuli"—such as humorous or sensational content—provides high-intensity, low-cost stimulation, thereby reinforcing a robust immediate reward loop. This significantly diminishes tolerance for activities requiring patience and high cognitive load, such as in-depth reading and long-term learning, leading behavioral patterns to favor rapid feedback and short-term stimulation.

5. Conclusion

Fragmented information under recommendation algorithms exerts sustained extraneous cognitive load characterized by broad topical spans and intense stimulation, which conflicts with adolescents' developmental needs to cultivate information integration skills, establish foundational frameworks, and develop deep, focused learning capabilities. This phenomenon not only erodes adolescents' attentional capacity and deep cognitive processing skills, leading to information overload, but also induces a shift in their cognitive strategies toward low-load, superficial processing. Behaviorally, there is an increasing reliance on immediate gratification, resulting in a pronounced avoidance of complex cognitive tasks. From a personal development perspective, it is advisable to encourage adolescents to reduce engagement in fragmented entertainment and instead focus on activities that require sustained concentration, such as in-depth reading, musical instrument training, or systematic physical training programs, thereby fostering skills in information integration and delayed gratification. From an educational perspective, it is essential to optimize curriculum design and classroom environment by implementing thematic and project-based learning approaches to enhance logical coherence. Reducing multimedia fragmentation minimizes cognitive distractions, thereby fostering a low-stimulation, high-focus learning environment that supports immersive cognitive construction among students.

This study, grounded in Cognitive Load Theory, systematically analyzes the profound impact of fragmented short-video information and recommendation algorithms on adolescents' cognitive processes and behavioral patterns. Research indicates that algorithm-driven high-frequency, highly stimulating fragmented information streams continuously impose excessive external cognitive load. This not only exacerbates attention fragmentation and information overload among adolescents but also leads to superficial cognitive processing, a decline in delayed gratification capabilities, and a tendency to avoid complex cognitive tasks. This mechanism fundamentally conflicts with the developmental needs of adolescents to construct systematic knowledge frameworks and cultivate deep concentration skills. This study offers a theoretical foundation for understanding the cognitive development challenges faced by adolescents in the era of short videos, from an interdisciplinary perspective combining cognitive psychology and information dissemination technology. Additionally, it provides practical guidance for subsequent media literacy education, algorithmic optimization, and the design of learning environments. Future research should further pursue long-term longitudinal studies and cross-cultural comparisons to thoroughly investigate the efficacy and

applicability boundaries of various intervention strategies, thereby supporting adolescents in achieving healthy cognitive and behavioral development within the digital ecosystem.

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