IRSTI 19.51.61 https://doi.org/10.26577/HJ81320263

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CHILDREN'S DIGITAL MEDIA PRACTICES WITHIN SOCIO-TECHNICAL NETWORKS: AN ACTOR-NETWORK THEORY (ANT) ANALYSIS OF XIAOHONGSHU ENGAGEMENT

This study investigates children's digital media behavior as an emergent phenomenon within socio-technical networks. The research aims to identify how interactions between human and non-human actors shape media consumption patterns and digital socialization on social media platforms. The scientific hypothesis posits that children's digital engagement is not merely an individual choice but a co-constructed behavior driven by the process of "translation" among family supervision, school integration, and platform algorithms. Methodologically, the study employs the Actor-Network Theory (ANT) as its theoretical framework, combining it with computational analysis and BERTopic modeling to examine user-generated content on the Xiaohongshu platform.

Data were processed through rigorous cleaning and semantic coding to map the discourse structure of children's digital participation. The findings reveal that Xiaohongshu's algorithmic recommendation systems and life-sharing culture deeply intersect with digital parenting concepts, creating relational dynamics that reinforce specific media habits. Furthermore, the results highlight long-term risks, such as content dependence and health issues, which are co-shaped by these multi-agent network mechanisms.

The practical significance of this study lies in its potential to inform policymakers and educators in developing effective digital literacy programs and "smart" parenting strategies that account for the algorithmic nature of modern childhood. The study concludes that children's digital participation is a complex socio-technical behavior determined by the continuous negotiation between human agency and technical structures.

Keywords: Xiaohongshu, actor-network theory (ANT), children, media consumption, BERTopic, digital parenting, algorithmic recommendations.

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Әлеуметтік-техникалық желілер контексіндегі балалардың цифрлық медиа тәжірибелері: Xiaohongshu платформасындағы өзара әрекетке Actor-Network Theory (ANT) негізіндегі талдау

Бұл зерттеу балалардың цифрлық медиа мінез-құлқын әлеуметтік-техникалық желілер аясында қалыптасатын құбылыс ретінде қарастырады. Зерттеудің мақсаты – әлеуметтік медиа платформаларындағы медиа тұтыну үлгілері мен цифрлық әлеуметтенудің адам және адамнан тыс (техникалық) акторлар арасындағы өзара әрекеттесу үдерісі арқылы қалай қалыптасатынын анықтау. Ғылыми гипотеза бойынша, балалардың цифрлық белсенділігі тек жеке таңдаудың нәтижесі емес, отбасылық бақылау, мектеп интеграциясы және платформа алгоритмдері арасындағы «аудару» (translation) үдерісі арқылы айқындалатын бірлескен мінез-құлық болып табылады. Зерттеу әдіснамасы аясында теориялық негіз ретінде Actor-Network Theory (ANT) қолданылып, компьютерлік талдау мен BERTopic модельдеуі арқылы Xiaohongshu платформасындағы пайдаланушылар жасаған контент зерттелді. Деректер балалардың цифрлық қатысу дискурсының құрылымын картаға түсіру мақсатында мұқият тазарту және семантикалық кодтау әдістері арқылы өңделді.

Зерттеу нәтижелері Xiaohongshu платформасының алгоритмдік ұсыным жүйелері мен күнделікті өмірмен бөлісу мәдениетінің цифрлық ата-аналық ұғымдарымен тығыз астарласып, белгілі бір медиа әдеттерді күшейтетін реляциялық динамика қалыптастыратынын көрсетті. Сонымен қатар контентке тәуелділік пен денсаулыққа қатысты мәселелер сияқты ұзақ мерзімді тәуекелдердің көпжақты желілік механизмдер арқылы өршитіні анықталды.

Зерттеудің практикалық маңызы — қазіргі балалық шақтың алгоритмдік табиғатын ескеретін тиімдірек цифрлық сауаттылық бағдарламалары мен «ақылды» ата-аналық

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әзірлеуде саясаткерлер мен педагогтерге бағыт-бағдар беру мүмкіндігінде. Зерттеу қорытындысында балалардың цифрлық қатысуы адамдық агенттілік пен техникалық құрылымдардың үздіксіз өзара әрекеті арқылы айқындалатын күрделі әлеуметтік-техникалық мінез-құлық екені дәлелденеді.

Түйін сөздер: Xiaohongshu, Actor-Network Theory (ANT), балалар, медиа тұтыну, BERTopic, цифрлық ата-аналық, алгоритмдік ұсынымдар.

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Цифровые медиапрактики детей в социально-технических сетях: анализ взаимодействия в Xiaohongshu на основе теории акторно-сетевых отношений (ANT)

Данное исследование рассматривает цифровое медиаповедение детей как формирующееся явление в рамках социально-технической сети. Цель исследования – определить, каким образом взаимодействие человеческих и нечеловеческих акторов влияет на модели медиапотребления и цифровой социализации на платформах социальных медиа. Научная гипотеза заключается в том, что цифровая вовлечённость детей является не просто личным выбором, а совместно сконструированным поведением, формирующимся через процесс «перевода» (translation) между семейным контролем, школьной интеграцией и алгоритмами платформ.

Методология исследования основана на смешанном подходе: в качестве теоретической основы используется Actor-Network Theory (ANT), совмещённая со смешанным вычислительным анализом и BERTopic-моделированием для анализа пользовательского контента на платформе Xiaohongshu. Данные были обработаны посредством тщательной очистки и семантического кодирования с целью картирования дискурсивной структуры цифрового участия детей.

Результаты показывают, что алгоритмические рекомендательные системы Xiaohongshu и культура обмена повседневной жизнью тесно пересекаются с концепциями цифрового родительства, формируя реляционную динамику, усиливающую определённые медиапривычки. Кроме того, выявлены долгосрочные риски, такие как зависимость от контента и проблемы со здоровьем, возникающие в результате многоакторных механизмов формирования.

Практическая значимость исследования заключается в возможности использования его результатов политиками и педагогами при разработке более эффективных программ цифровой грамотности и стратегий «умного» родительства, учитывающих алгоритмическую природу современного детства. В заключение исследование показывает, что цифровое участие детей представляет собой социально-техническое поведение, формирующееся в результате постоянного взаимодействия человеческих акторов и технических структур.

Ключевые слова: Xiaohongshu, Actor-Network Theory (ANT), дети, медиапотребление, BERTopic, цифровое родительство, алгоритмические рекомендации.

Introduction

The actual situation and challenges surrounding Chinese children's use of new technologies have attracted increasing attention. The Statistical Report on Internet Development in China (China Internet Network Information Center [CNNIC], 2024) indicates that there are approximately 185 million young netizens in China, with the trend toward internet adoption shifting to increasingly younger demographics. According to this report, 55.2% of adolescents spend an average of less than one hour per day on the internet, while 13.6% spend more than three hours per day. Assessments of adolescents' internet literacy consider various dimensions, including cognitive, emotional, behavioral, cultural, and environmental adaptability. Current research shows that while cognitive and behavioral skills are relatively high, emotional regulation and cultural adaptability remain lower, implying a critical need for enhanced humanistic and value-based education (Livingstone et al., 2017). Simultaneously, despite the influence of parental mediation, school management, and platform governance, adolescents' mobile phone use continues to expand. In recent years, children's media consumption has evolved from isolated, single-device use to active participation within networked digital environments.

The increasing tendency for children to engage with online platforms at younger ages suggests that digital media are becoming deeply embedded in everyday life (Orben, 2020). Existing studies mainly focus on individual or behavioral factors, such as parenting styles or school regulation, while paying

less attention to the broader socio-technical relations that shape children's media practices. To address this gap, this study combines Actor-Network Theory (ANT) with BERTopic-based computational analysis to examine user-generated content on Xiaohongshu. As an algorithm-driven and highly interactive platform, Xiaohongshu offers a compelling case for exploring how interactions among families, schools, platforms, and technological systems shape children's digital media practices.

Although the study is based on data from a Chinese platform, its analytical relevance extends far beyond a single national context. Rapid digitalization in Central Asia—characterized by expanding smartphone access, platform proliferation, and digitally mediated education—has generated growing concerns regarding screen time, online safety, and digital literacy among children. Similar to the Chinese context, these developments involve complex tensions among family regulation, school-based digitalization, and platform-mediated interaction. Therefore, rather than directly generalizing the Chinese case, this study utilizes it as a theoretically informative paradigm for understanding how socio-technical relations shape children's media practices in rapidly digitalizing societies.

These findings on the co-construction of children's digital practices by algorithms, families, and schools are highly relevant to Kazakhstan and the broader Central Asian region. Kazakhstani children access the internet at increasingly younger ages, with 46% going online between the ages of 5 and 8, and 5% before the age of 4 (UNICEF, 2024). Platforms such as TikTok and YouTube dominate children's online time; their algorithmic recommendation mechanisms are structurally similar to those of Xiaohongshu, shaping comparable patterns of attention capture and behavioral dependence (Global Kids Online, 2024).

Furthermore, severe online risks – including cyberbullying, sharing personal photos with strangers, and excessive screen time – have been widely documented among Kazakhstani children (Global Kids Online, 2024; UNICEF, 2025). Meanwhile, Kazakhstan is rapidly advancing educational digitalization and artificial intelligence (AI) integration in schools, creating a typical pathway of "legitimized device use at school leading to passive parental regulation at home" (The Astana Times, 2025). The scarcity of high-quality, local-language children's content further amplifies the influence of international algorithms (Kursiv Media Kazakhstan, 2025). Thus, this study's socio-technical framework provides a valuable diagnostic lens for decoding children's digital practices in Kazakhstan.

This study aims to answer the following research questions:

(1) How do platforms, families, and schools interactively shape children's digital media use on Xiaohongshu?

(2) How do recommendation systems, parental control, and digital learning practices influence children's screen engagement and behavioral dependency?

Literature review

Children's digital media practices have become increasingly embedded in socio-technical environments shaped by families, schools, and digital platforms. Existing studies have provided important insights into children's screen time, media literacy, and psychological outcomes; yet, much of the literature examines these factors separately rather than as interconnected processes within broader digital environments.

To address this limitation, this study combines ANT with computational analysis. ANT provides a framework for examining how human and non-human actors – including parents, schools, platforms, algorithms, and devices – interact to shape behavioral patterns. At the same time, computational tools such as topic modeling enable large-scale analysis of digital traces and online interactions.

This section reviews the literature in three parts. First, it introduces ANT as a theoretical framework for analyzing socio-technical systems. Second, it reviews studies on children's digital media use in relation to family, platform, and school influences. Third, it identifies existing research gaps and explains how this study integrates ANT with computational analysis.

ANT, developed by Latour, Callon, and Law, explains social phenomena through interactions among heterogeneous actors, including both human and non-human entities (Callon, 1986; Latour, 2005; Law, 1992). Unlike traditional sociological approaches centered mainly on human agency, ANT considers technologies, algorithms, institutions, and infrastructures as active participants in the production of social outcomes. A central assumption of ANT is that social order is continuously produced through relations among actors rather than existing independently in advance. In digital environments, behaviors emerge through interactions among users, platforms, technological systems, and institutional

structures. ANT therefore offers a useful framework for examining how children's digital media practices are shaped within interconnected socio-technical environments.

Another important concept in ANT is translation, which refers to the processes through which actors define problems, negotiate relationships, and stabilize networks. Translation involves four stages: problematization, interessement, enrollment, and mobilization. These stages help explain how behavioral patterns become organized and sustained over time. ANT has been widely applied in media and communication research to analyze the role of technologies in shaping social practices. For instance, Couldry and Hepp (2017) argue that media processes are deeply integrated into everyday life, while Hepp (2020) highlights the growing importance of digital infrastructures in communication processes. These studies suggest that media practices should be understood within broader socio-technical relations rather than solely as individual behaviors.

Children's Digital Media Use and Multi-Actor Influences

Research on children's digital media use has expanded significantly, particularly regarding screen time, well-being, and media literacy. Existing studies indicate that excessive screen time may be associated with negative outcomes such as sleep problems, reduced well-being, and attention difficulties (Orben, 2020). However, these effects are difficult to understand without considering the wider social and technological contexts in which media use occurs. Parental mediation represents one major area of research. Parents influence children's media use through supervision, restriction, communication, and co-use strategies. At the same time, parental regulation is often shaped by external factors, including educational demands and platform design.

Digital platforms and recommendation algorithms also play an important role in shaping online behaviour. Recent studies further suggest that Xiaohongshu promotes highly visual and affective forms of interaction shaped by platform aesthetics and algorithmic visibility (Ge et al., 2025). Interface design, personalised recommendations, and content visibility influence what users watch and how long they remain engaged. Previous studies show that algorithmic systems can reinforce repetitive engagement patterns and habitual media consumption (Bucher, 2018; Gillespie, 2014). Schools and educational systems have likewise become increasingly involved in children's digital media practices. The integration of online assignments, learning platforms, and digital communication tools has normalised device use within educational settings (Selwyn, 2016). As a result, children's digital media use is shaped simultaneously by family regulation, platform affordances, and institutional expectations. Research Gap: Toward an Integrated ANT-Based Analysis. Despite growing research interest in children's digital media use, several limitations remain. First, many studies examine psychological outcomes, parental mediation, or platform design separately, making it difficult to understand how these factors interact within broader socio-technical systems. Second, although socio-technical perspectives are increasingly recognised, ANT is often referenced only descriptively and is rarely operationalised as an analytical framework for examining how networks are formed and stabilised through translation processes. Third, theoretical and methodological approaches are often disconnected. Computational methods such as topic modelling allow large-scale analysis of digital data, yet they are frequently applied without strong theoretical grounding. Conversely, theoretically oriented studies sometimes lack empirical depth when analysing large-scale digital interactions.

Methodology

This study employs computational content analysis combining BERTopic modelling with qualitative thematic interpretation. By integrating ANT with BERTopic-based analysis, the study enables both empirical identification of thematic patterns and theoretical examination of how actors, technologies, and institutional structures interact within children's digital media environments.

A 20-day observation of Xiaohongshu was conducted using a newly created account to minimise algorithmic influence. However, the observation was used only to understand platform context and keyword dynamics rather than to provide immersive ethnographic interpretation. Since ethnographic research typically involves prolonged immersion and interpretive engagement (Hine, 2020; Pink et al., 2020), this study is more appropriately characterised as a mixed-methods approach combining computational topic modelling with qualitative thematic analysis based on large-scale digital trace data (Kozinets, 2020; Kim et al., 2024).

The research data were collected from Xiaohongshu using keywords related to children's digital media use, including smartphone use, screen time, and short-video engagement. Approximately 98,000

posts and comments were initially gathered. Following duplicate removal, exclusion of irrelevant content, filtering of advertisements and spam, removal of incomplete entries, and contextual verification, a final cleaned corpus of 4,160 valid comments was established (Grimmer et al., 2021).

BERTopic modelling was then applied using transformer-based embeddings, UMAP dimensionality reduction, and HDBSCAN clustering. During intertopic visualisation, dimensionality reduction and outlier filtering produced a clustered topic representation (n = 1,002), meaning that the intertopic map reflects clustered topic representations rather than the entire cleaned corpus (n = 4,160).

The analysis combined BERTopic modelling with human coding. BERTopic uses transformer embeddings and clustering techniques to identify semantic patterns within large-scale text data. In this study, the text data were converted into contextual embeddings, reduced in dimensionality, and clustered into topics, with representative keywords extracted for each topic. Since topic modelling alone cannot fully explain thematic meaning, manual coding was introduced to support interpretation. Open coding was used to identify initial concepts, axial coding to establish relationships between categories, and selective coding to develop higher-level themes. This combination enabled data-driven pattern discovery alongside theory-informed interpretation, consistent with approaches in contemporary computational social science (Nelson, 2020).

Several validation procedures were applied to evaluate the BERTopic results. First, topic coherence was examined to assess whether keywords within each topic formed semantically meaningful groupings. Second, topic distinctiveness was evaluated to ensure sufficient differentiation between clusters and to minimize excessive overlap. Third, representative documents from each topic were manually reviewed to verify the consistency between algorithmic outputs and contextual text meanings. Finally, the BERTopic results were systematically compared with categories generated through manual open, axial, and selective coding. Discrepancies between machine-generated topics and human interpretation were resolved through iterative category refinement, ensuring that the computational findings were critically interpreted rather than treated as self-evident outputs (Kim et al., 2024).

To enhance methodological transparency, quantitative validation measures were strictly integrated. Topic coherence was calculated using the c_v measure, yielding a mean coherence score of 0.52. Additionally, inter-coder reliability for the manual qualitative coding process was assessed using Cohen's Kappa, which reached 0.78, indicating a high level of substantial agreement between coders. Together, these measures confirm the reliability, robustness, and interpretability of both the computational and qualitative components of the analysis.

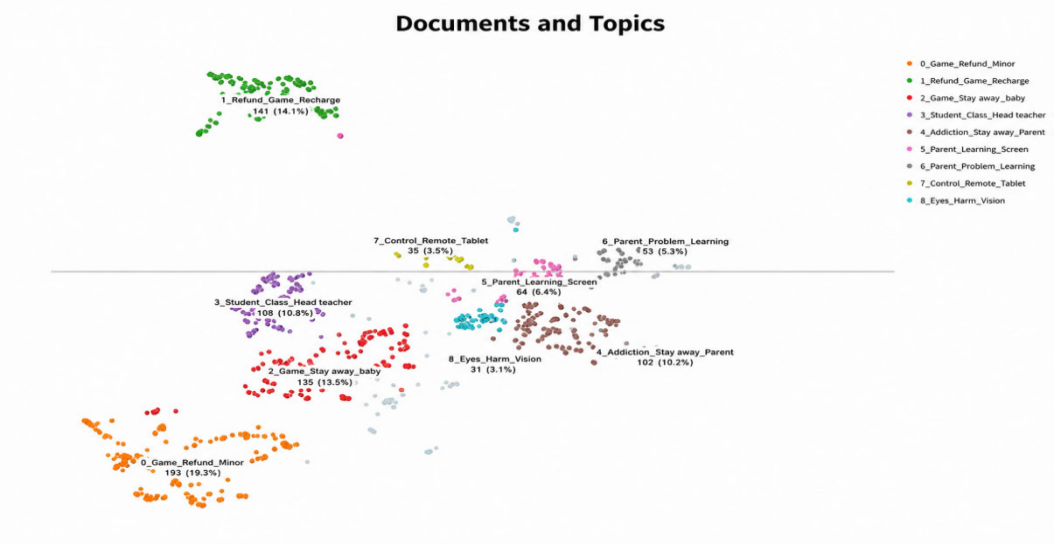
Ethical considerations were carefully addressed throughout the research process. This study utilized exclusively publicly available data from Xiaohongshu and did not involve any confidential or restricted information. To ensure privacy, all personal identifiers, including usernames and geotags, were permanently removed during the preprocessing stage; no users were identified, tracked, or contacted. Given that the study implicitly involves data concerning minors, extra care was taken to anonymize and aggregate all textual data to prevent any re-identification. The research strictly adheres to international principles of digital ethics, data minimization, and non-harm (Franzke et al., 2020; Markham et al., 2020).

Results and discussion

The BERTopic analysis identified several distinct thematic clusters within the dataset. Comments related to recommendation systems, short-video feeds, and repetitive viewing behaviour formed some of the densest semantic clusters, suggesting that algorithmic systems play a central role in shaping children's attention and engagement. Discussions concerning parental restriction and school-based digital learning frequently appeared alongside themes of prolonged screen exposure, indicating that family regulation and educational digitalisation are closely intertwined with platform use. In addition, behavioural outcomes such as dependency, distraction, and health concerns were often associated with platform-related discussions, suggesting that these risks emerge through overlapping socio-technical interactions rather than isolated individual behaviour.

The topic distribution map shows that discussions related to platform use and behavioural immersion occupied some of the most concentrated semantic regions within the dataset. Topic 0 (19.3%), Topic 1 (14.1%), and Topic 2 (13.5%) formed relatively clear and densely packed clusters, indicating strong thematic coherence around gaming behaviour, short-video exposure, and digital immersion.

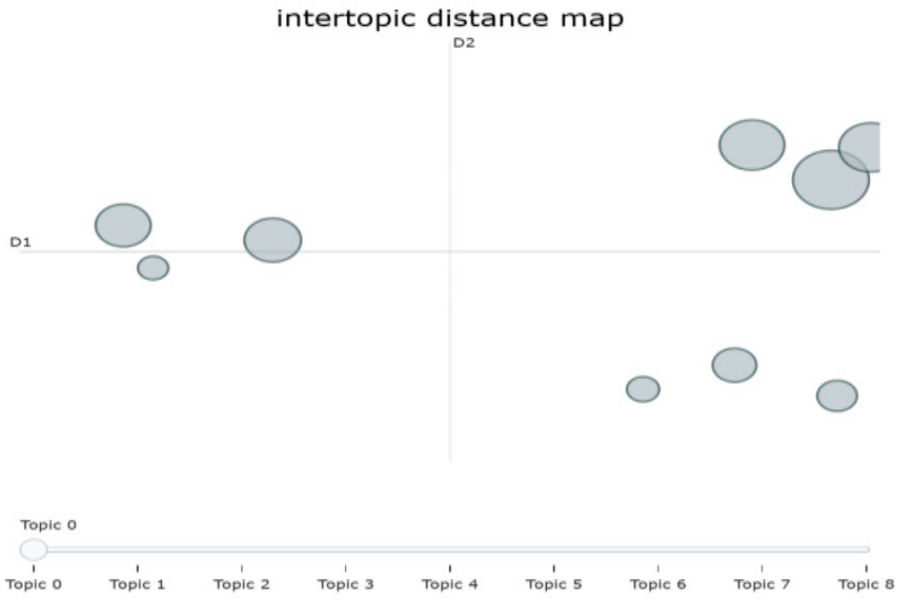
Figure 1
Topic Distribution Scatter Plot of Children's Digital Media Practices



Note: Compiled by the authors

In comparison, topics related to parental mediation, including Topic 5 (6.4%) and Topic 6 (5.3%), appeared more dispersed, suggesting greater variation in how families manage and respond to children's media use. School-related discussions represented by Topic 3 (10.8%) formed a relatively stable cluster, indicating that school regulation also remained an important part of children's digital media practices. Overall, the clustering structure suggests that the topics were organised around several dominant discussion patterns within the socio-technical network rather than being randomly distributed.

Figure 2
Semantic Distance Map of Topic Relationships



Note: Compiled by the authors

Figure 2 shows that the topics formed relatively clear cluster structures rather than being randomly distributed. The clusters located in the upper-right region were positioned close to one another, indicating strong semantic relationships among discussions related to platform engagement, behavioural immersion, and parental supervision. This suggests that concerns about children's screen-time management frequently appeared together with issues of platform recommendation, repetitive use, and digital dependency.

By comparison, lower-right clusters were more dispersed, showing that discussions of behavioural risks, family responses, and educational concerns were related yet distinct. Left-side clusters stood apart, indicating gaming- and entertainment-focused media use formed relatively independent themes.

The semantic distance map confirms structured, non-random topic distribution: closely positioned clusters reflect strong thematic links (e.g., supervision and behavioural outcomes), while distant clusters show weaker connections. These results reveal children's online practices as interconnected yet distinct socio-technical elements, supporting both the topic modelling (Egger & Yu, 2022) and the ANT translation framework's utility in explaining how actors and mechanisms combine to shape children's digital media behaviours.

Table 1
Mapping BERTopic Topics to ANT Translation Processes

Topic Cluster	Key Actors	Mechanism	ANT Translation Stage	Network Effect
Algorithmic immersion / content addiction	Platforms, algorithms, children	Recommendation systems, infinite scroll, personalised feeds	Interessement	Locks children into repetitive engagement patterns
Parental control and mediation	Parents, children	Restriction, monitoring, negotiation	Enrolment	Stabilises the parent-child regulatory functions.
School digital integration	Schools, platforms, children	Digital assignments, platform-based learning	Problematization / Enrolment	Defines device use as necessary to learn
Peer interaction and social exposure	Children, platforms	Social sharing, imitation, peer influence	Interessement	Enhances engagement and content sharing.
Behavioural outcomes (addiction, distraction, health risks)	All actors	Habit formation, repetition, dependency	Mobilisation	Produces stable and self-reinforcing behaviour patterns.

Note: Compiled by the authors

The findings show children's digital media practices arise from interactions among families, schools, platforms, and technologies—not isolated individual choices. Parents supervise and negotiate media use, schools normalize device use via digital assignments and online learning, and platforms shape engagement through recommendations, interface design, and content visibility. Smartphones and algorithms drive attention and repetitive engagement. These themes correspond to different parts of the socio-technical network, including algorithmic influence, parental mediation, institutional integration of digital technologies, and behavioural outcomes such as dependency and distraction (Konok et al., 2020; Livingstone et al., 2017).

Comments in the dataset often framed children's media use as a problem tied to discipline, academic performance, and health. Many noted children repeatedly returning to algorithm-recommended short videos despite parental restrictions.

These patterns align with Callon's four moments of translation. Recommendation systems and personalized feeds act as interessement mechanisms, directing attention toward repetitive engagement. Parental supervision and school digital demands reflect enrolment, while mobilisation emerges through routine media use, prolonged screen time, and behavioural dependency.

The figure illustrates relationships among actors, mechanisms, and behavioural outcomes within the socio-technical network. It consists of three interconnected layers: actors (families, schools, platforms, children, and technological systems), mechanisms (parental control, algorithmic recommendation, educational integration, peer interaction, and content exposure), and outcomes (behavioural

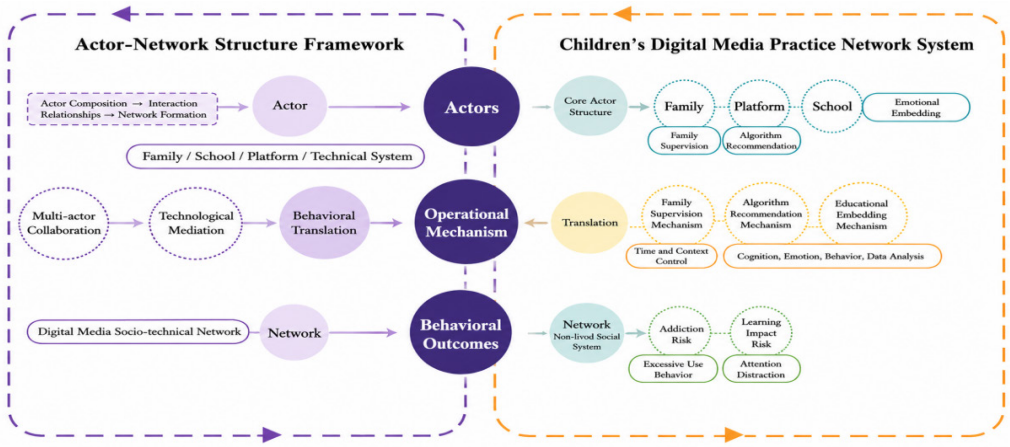
dependency, learning distraction, health risks, and media literacy challenges).

The findings suggest that children's media practices are shaped through overlapping influences from families, platforms, and schools. Families regulate media use through supervision and negotiation, platforms shape engagement through recommendation systems and interface design, while schools normalise device use through online learning systems and digital assignments. Together, these interactions form an interconnected family–platform–school network that structures children's digital media practices.

The findings also reveal a structural tension between educational digitalisation, parental regulation, and platform-driven engagement. School-based digital tasks increased children's routine access to devices, while recommendation systems extended this exposure into entertainment-oriented use. Parents therefore often responded reactively by adjusting supervision strategies after prolonged engagement had already occurred. These interaction patterns suggest that children's media practices are shaped through overlapping and sometimes contradictory pressures within the family–platform–school system rather than by a single dominant actor.

Figure 3

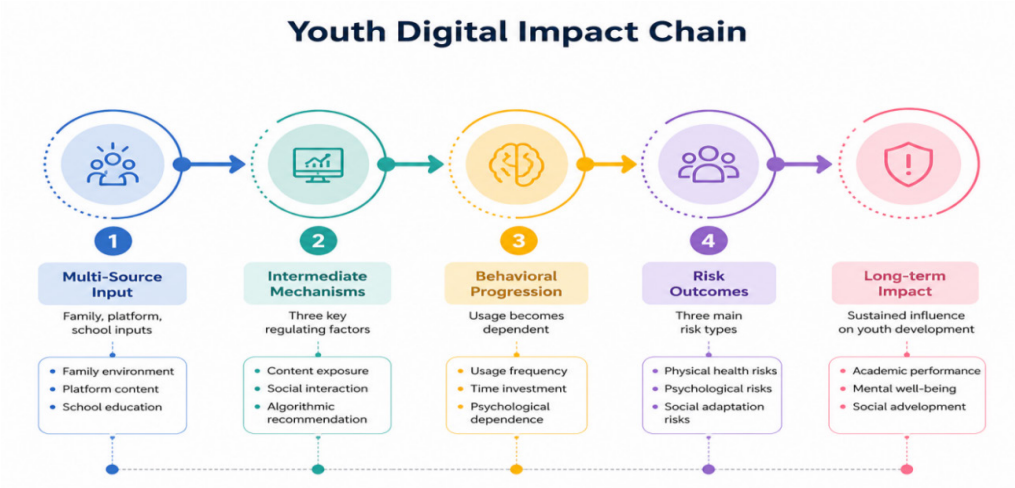
Multi-Actor Network Structure of Children's Digital Media Practices (ANT Framework)



Note: Compiled by the authors

Figure 4

Multi-Actor Risk Propagation Pathway Model



Note: Compiled by the author

This model illustrates how interactions among families, schools, platforms, and technological systems contribute to behavioural, learning, and health-related risks within the socio-technical network. As shown in Figure 3, three major categories of risk emerged from the findings: behavioural dependency, learning distraction, and health problems such as sedentary behaviour and eye strain. Platform recommendation systems, social interaction, and content exposure further functioned as intermediate mechanisms shaping children's patterns of engagement and repetition.

BERTopic analysis enabled the empirical identification of thematic patterns, while ANT provided a framework for interpreting how these patterns were formed through relations among actors, technologies, and institutional structures. In this sense, the visualisations function not only as descriptive illustrations but also as analytical representations of socio-technical interactions (Kozlowski et al., 2022; Nelson, 2020)

Conclusion

This study examined children's digital media use through the combined application of Actor-Network Theory (ANT) and BERTopic-based computational content analysis. Drawing on user-generated data collected from Xiaohongshu, the findings suggest that children's media practices do not emerge solely from individual choice, but are gradually shaped through ongoing interactions among families, schools, platforms, and technological systems. Based on platform discussions, topic clustering, and semantic relationships, the study analysed issues such as behavioural dependency, platform immersion, parental regulation, and digital learning practices, while attempting to explain the formation of children's media behaviours from the perspective of socio-technical networks.

Based on the findings, the study's assumption that children's digital media behaviour demonstrates characteristics of co-constructed behaviour was supported to a certain extent. Topic clustering results showed that platform-related discussions displayed relatively concentrated semantic structures, particularly around algorithmic recommendation, repetitive short-video exposure, and behavioural dependency, suggesting that platform mechanisms played a relatively prominent role in shaping children's media engagement. In contrast, family-related discussions appeared more dispersed, reflecting differences in parental regulation, educational attitudes, and media negotiation across households, while school-related themes indicated the increasing integration of digital learning into children's everyday media practices. At the theoretical level, this study attempted to move ANT beyond conceptual discussion and apply it more directly to the analytical process. The findings suggest that recommendation systems, parental regulation, and digital learning practices did not operate independently, but jointly shaped children's patterns of media engagement through ongoing interactions. In particular, platforms continuously reinforced repetitive exposure and prolonged engagement through algorithmic recommendation and content visibility, while families mainly responded through supervision, restriction, and negotiation. Schools further normalised device use through digitally mediated learning tasks. Together, these elements formed the socio-technical interaction mechanisms underlying children's digital media practices. At the same time, BERTopic modelling and qualitative analysis indicated that behavioural dependency, learning distraction, and health-related concerns could not be explained by a single factor alone, but instead gradually emerged through interactions among platforms, families, schools, and technological systems. These findings suggest that children's digital media practices are both interconnected and structurally differentiated, with different actors exerting varying levels of influence within the network. Rather than attempting to make direct empirical generalisations beyond the Chinese context, this study aims to provide a socio-technical analytical perspective for understanding children's media practices in rapidly digitalising societies. Recent UNICEF reports on Kazakhstan also indicate that digital technologies and online learning systems have become increasingly integrated into children's educational and everyday environments, while internet penetration and mobile platform use continue to expand across the country. At the same time, policy discussions in Kazakhstan have increasingly focused on digital inclusion, online safety, and the governance challenges associated with children's digital participation. In this sense, the Chinese case may provide a useful socio-technical reference for understanding similar interactions among platforms, families, schools, and technological systems in rapidly digitalising contexts (UNICEF, 2026).

Combined with China's children's media environment, this analysis adopts a multi-actor socio-technical perspective informed by ANT. It finds that Kazakhstan exhibits relational dynamics consistent with those identified in this study: al-

gorithmic recommendation mechanisms foster repetitive engagement and behavioural dependency; school-based digital learning normalises device use; parental mediation tends to be reactive rather than proactive. These consistent socio-technical configurations platform algorithmic mechanisms, institutionalised school digitalisation, and family regulatory tensions render the findings comparatively applicable to examining how human and non-human actors collectively shape children's digital media practices in the Kazakhstani context.

Nevertheless, the study still has certain limitations. The analysis was primarily based on publicly available social media text data and therefore focused more on discursive representations of children's digital media practices rather than direct behavioural observation. In addition, the study focused on a single platform environment, while BERTopic results still required contextual interpretation. Future studies could further combine multi-platform, longitudinal, and cross-cultural approaches to deepen understanding of the socio-technical mechanisms underlying children's digital media practices.

Overall, this study attempts to combine computational analytical methods with socio-technical theory to examine multi-actor interactions within children's digital media practices, while also offering practical implications for digital parenting, platform governance, and media education.

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All authors have read and agreed to the published version of the manuscript.

References

Bucher, T. (2018). *If... then: Algorithmic power and politics*. Oxford University Press. https://doi.org/10.1093/oso/9780190493028.001.0001

Callon, M. (1986). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay. In J. Law (Ed.), *Power, action and belief: A new sociology of knowledge?* (pp. 196–223). Routledge. https://doi.org/10.4324/9780203982914

China Internet Network Information Center. (2024). *Statistical report on internet development in China*. CNNIC. https://www.cnnic.net.cn/

Couldry, N., & Hepp, A. (2017). *The mediated construction of reality*. Polity Press. https://www.politybooks.com/bookdetail?book_slug=the-mediated-construction-of-reality--9780745680033

Egger, R., & Yu, J. (2022). A topic modeling comparison between LDA, NMF, Top2Vec, and BERTopic to demystify Twitter posts. *Frontiers in Sociology*, 7. https://doi.org/10.3389/fsoc.2022.886498

Franzke, A. S., Bechmann, A., Zimmer, M., & Ess, C. (2020). *Internet research: Ethical guidelines 3.0*. Association of Internet Researchers. https://aoir.org/reports/ethics3.pdf

Ge, J., Zheng, X., & Tian, W. (2025). Erotic capital in the digital age: A multimodal analysis of Xiaohongshu. *Social Semiotics*. https://doi.org/10.1080/10350330.2025.2473996

Gillespie, T. (2014). The relevance of algorithms. In T. Gillespie et al. (Eds.), *Media technologies: Essays on communication, materiality, and society* (pp. 167–194). MIT Press. https://doi.org/10.7551/mitpress/9780262525374.003.0009

Global Kids Online. (2024). *Kazakhstan Kids Online*. http://globalkidsonline.net/kazakhstan/

Grimmer, J., Roberts, M. E., & Stewart, B. M. (2021). *Text as data: A new framework for machine learning and the social sciences*. Princeton University Press. https://press.princeton.edu/books/hardcover/9780691207544

Hepp, A. (2020). *Deep mediatization*. Routledge. https://doi.org/10.4324/9780429464416

Hine, C. (2020). *Ethnography for the internet: Embedded, embodied and everyday*. Bloomsbury. https://doi.org/10.5040/9781350141370

Kim, K., Kogler, D. F., & Maliphhol, S. (2024). Identifying interdisciplinary emergence using BERTopic. *Humanities and Social Sciences Communications*, 11. https://doi.org/10.1057/s41599-024-03004-y

Konok, V., Bunford, N., & Miklósi, Á. (2020). Associations between child mobile use and digital parenting style. *Journal of Children and Media*, 14(1), 91–109. https://doi.org/10.1080/17482798.2019.1684339

Kozinets, R. V. (2020). *Netnography: The essential guide to qualitative social media research* (3rd ed.). Sage. https://us.sagepub.com/en-us/nam/netnography/book262051

Kozlowski, A. C., Taddy, M., & Evans, J. A. (2022). The geometry of culture: Analyzing meaning through word embeddings. *American Sociological Review*, 87(1), 1–31. https://doi.org/10.1177/00031224211068214

Kursiv Media Kazakhstan. (2025, June 2). *Qalam launches digital media for children and teenagers in Kazakhstan*. https://kz.kursiv.media/en/2025-06-02/engk-tank-qalam-launches-digital-media-for-children-and-teenagers-in-kazakhstan/

Latour, B. (2005). *Reassembling the social: An introduction to actor-network theory*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199256051.001.0001

Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systems Practice*, 5(4), 379–393. https://doi.org/10.1007/BF01059830

Livingstone, S., Mascheroni, G., & Staksrud, E. (2017). European research on children's internet use: Assessing the past and anticipating the future. *New Media & Society*, 20(3), 1103–1122. https://doi.org/10.1177/1461444816685930

Markham, A., Tiidenberg, K., & Herman, A. (2020). Ethics as methods: Doing ethics in the era of big data. *Social Media + Society*, 6(3). https://doi.org/10.1177/2056305120940407

Nelson, L. K. (2020). Computational grounded theory. *Sociological Methods & Research*, 49(1), 3–42. https://doi.org/10.1177/0049124117729703

Orben, A. (2020). The effects of digital technology on well-being. *Nature Human Behaviour*, 4, 10–19. https://doi.org/10.1038/s41562-019-0791-9

Pink, S., Horst, H., Postill, J., Hjorth, L., Lewis, T., & Tacchi, J. (2020). *Digital ethnography: Principles and practice* (2nd ed.). Sage. https://uk.sagepub.com/en-gb/eur/digital-ethnography/book258022

Selwyn, N. (2016). *Education and technology: Key issues and debates* (2nd ed.). Bloomsbury. https://www.bloomsbury.com/uk/education-and-technology-9781474223787

The Astana Times. (2025, September 18). *Kazakhstan establishes national standards for artificial intelligence in education*. https://astanatimes.com/2025/09/kazakhstan-establishes-national-standards-for-artificial-intelligence-in-education/

UNICEF. (2024, February 8). *UNICEF launches campaign in Kazakhstan to foster safe digital space for children*. https://astanatimes.com/2024/02/unicef-launches-campaign-in-kazakhstan-to-foster-safe-digital-space-for-children/

UNICEF. (2025, May 12). *Every 10th child in Kazakhstan has sent their photos to strangers – UNICEF study*. https://en.avesta.tj/2025/05/12/every-10th-child-in-kazakhstan-has-sent-their-photos-to-strangers-unicef-study/

UNICEF. (2026). *Artificial intelligence and child sexual abuse and exploitation*. UNICEF Office of Strategy and Evidence. https://www.unicef.org/reports/artificial-intelligence-and-child-sexual-abuse-and-exploitation

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Received: February 11, 2026
Accepted: June 27, 2026