ETHICAL CONSIDERATIONS IN MODELING INFORMATION DIFFUSION: A COMPUTATIONAL SOCIAL SCIENCE PERSPECTIVE

Hoang Tung
Dong Nai University
Email: tungaptechbd@gmail.com
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ABSTRACT

Information diffusion modeling is a key approach in Computational Social Science (CSS), offering insights into how interactions on digital platforms shape collective behavior. Despite its growing use, the ethical aspects of diffusion modeling, such as privacy, consent, transparency, and potential bias remain insufficiently addressed, particularly in developing digital contexts like Vietnam. This paper outlines the main ethical challenges involved in studying information diffusion and explains why these issues are crucial for ensuring fairness, accountability, and scientific rigor. By synthesizing relevant international research and considering local digital characteristics, the study proposes core ethical principles to guide responsible CSS practice and support future work on ethically informed diffusion modeling.

Keywords: *Algorithmic bias; computational social science; data ethics; information diffusion; social network analysis*

1. Introduction

The rapid expansion of digital platforms has fundamentally transformed how information is produced, shared, and consumed. As online interactions increasingly shape social life, Computational Social Science (CSS) has emerged as a major interdisciplinary field integrating social theory, computational modeling, and large-scale data analysis to examine complex social phenomena [1–3]. Within CSS, information diffusion modeling has become a central area of research, offering insight into how ideas, behaviors, and digital content spread through networked environments [4–5].

Much existing research has focused primarily on improving predictive accuracy, cascade analysis, and algorithmic sophistication through probabilistic, network-based, and machine learning approaches [6–7]. These models are now widely applied in domains including viral marketing, recommendation systems, misinformation detection, and behavioral prediction. However, as diffusion modeling becomes increasingly embedded in digital infrastructures, ethical concerns—including privacy, consent, transparency, re-identification, and algorithmic bias—have become more consequential for both research integrity and societal impact [8–10].

Despite growing attention to AI ethics and data governance, diffusion-specific ethical analysis remains comparatively underdeveloped. Early computational research often relied on assumptions that publicly accessible or anonymized digital trace data posed limited ethical concern [11], while methodological priorities frequently emphasized performance over normative implications such as representational bias, behavioral manipulation, or inequitable outcomes [12–13]. Yet diffusion modeling presents distinctive ethical challenges because it often reconstructs relational structures,

temporal cascades, and inferred influence pathways that may expose sensitive social dynamics beyond conventional data privacy concerns.

These challenges may be particularly significant in emerging digital ecosystems such as Vietnam, where rapid digitalization has expanded platform-based social interaction while ethical governance frameworks for computational research remain relatively fragmented [14–15]. Although CSS is increasingly relevant for studying digital behavior in Vietnam, domestic scholarship has focused largely on technical or applied objectives, with comparatively limited attention to diffusion-specific ethical governance. This creates both a conceptual and methodological gap, especially as diffusion models may shape recommendation systems, content moderation, digital marketing, or misinformation governance within evolving socio-technical environments.

In response, this study provides an analytical literature review of ethical issues in information diffusion modeling and develops a diffusion-centered ethical framework tailored to Computational Social Science. Specifically, the paper: (1) identifies core ethical risks associated with data privacy, consent, transparency, bias, and accountability; (2) connects ethical theory with methodological practices in diffusion research; and (3) contextualizes these challenges within Vietnam's developing digital ecosystem.

Rather than treating ethics as an external limitation, this paper argues that ethical reflection should be integrated throughout the diffusion research pipeline—from data collection and network analysis to modeling, interpretation, and application. By synthesizing international scholarship while adapting it to local digital conditions, this study aims to support more transparent, context-sensitive, and socially responsible diffusion research.

2. Research method

This study employs an analytical literature review approach to synthesize scholarship on ethical issues in information diffusion modeling within Computational Social Science (CSS). The review focuses on conceptual, methodological, and socio-technical discussions related to digital-trace research, network analysis, algorithmic modeling, and platform-based information diffusion.

Relevant literature was collected primarily through Google Scholar and Scopus using keyword combinations including "information diffusion," "computational social science," "diffusion modeling ethics," "algorithmic bias," "data privacy," "digital trace data," "network analysis ethics," and "platform governance." Priority was given to peer-reviewed journal articles, influential conference papers, and foundational theoretical works.

The review primarily covers publications from 2010 to 2024 in order to capture contemporary developments in digital platforms, computational methods, and data ethics, while also incorporating earlier foundational studies central to diffusion theory and network research [4], [16–17].

Sources were selected based on three criteria:

(1) relevance to information diffusion or CSS;

(2) contribution to ethical, methodological, or socio-technical debates; and

(3) conceptual or scholarly influence within the broader literature.

Rather than conducting a statistical meta-analysis, this study adopts an interpretive analytical framework to identify recurring ethical themes, conceptual gaps, and emerging challenges. This approach is appropriate because scholarship on diffusion modeling ethics remains fragmented across multiple disciplines, including sociology, communication studies, network science, and AI ethics.

3. Literature review

Literature on information diffusion modeling spans sociology, communication studies, network science, and computational modeling. To clarify both the intellectual foundations of diffusion research and the ethical limitations of current scholarship, this review synthesizes prior work across four domains: (1) theoretical foundations of diffusion; (2) computational models and methodological developments; (3) data practices in large-scale digital research; and (4) ethical discussions in Computational Social Science (CSS).

3.1. Theoretical foundations of information diffusion

Foundational diffusion theory originates in Rogers' *Diffusion of Innovations* (2003), which conceptualized diffusion as the spread of ideas and behaviors through communication channels over time within social systems. Although developed prior to digital platforms, Rogers' emphasis on communication structure, adopter categories, and social influence remains central to contemporary diffusion research [4].

Network sociology further shifted attention from individual attributes to relational structures. Granovetter's (1973) strength of weak ties [16] and Burt's (1992) structural holes theory demonstrated that network position strongly shapes information flow, thereby providing the conceptual basis for later computational network analysis [17].

Digital platforms, however, transformed diffusion from primarily interpersonal communication into platform-mediated socio-technical processes. Research on Facebook and Twitter demonstrated that online diffusion is shaped not only by social ties but also by algorithmic curation, personalization, and platform architectures [5], [18]. This distinction is ethically important because online visibility and influence are increasingly structured by recommendation systems and platform governance rather than solely by voluntary interpersonal exchange [19–20].

3.2. Computational models of information diffusion

Computational diffusion research formalized diffusion through probabilistic and optimization-based models such as the Independent Cascade (IC) and Linear Threshold (LT) frameworks [6]. Subsequent work incorporated temporal dynamics, content features, and user heterogeneity, significantly improving predictive performance [7], [21].

More recent developments include machine learning, graph-based modeling, and causal inference approaches designed to distinguish correlation from genuine influence [22–23]. These advances have expanded the analytical power of diffusion research but have also intensified ethical concerns. Because diffusion models frequently rely on relational, temporal, and behavioral inference, higher predictive precision may require increasingly intrusive forms of data extraction and network reconstruction [8], [24].

Unlike many predictive systems that classify user traits, diffusion models often infer hidden pathways of influence—who affects whom, under what conditions, and through which structures. This makes ethical concerns intrinsic to diffusion modeling itself, rather than secondary issues limited to data collection.

3.3. Data practices in large-scale digital research

CSS relies heavily on digital trace data, including social media activity, metadata, clickstreams, and location records [25]. While these data provide substantial analytical opportunities, they also create significant ethical challenges.

A central issue is the unstable boundary between public and private data. Public accessibility does not automatically imply ethical legitimacy, particularly when users misunderstand platform visibility or data reuse practices [11], [26]. Re-identification research further demonstrates that anonymization alone may be insufficient, especially when temporal or structural metadata are involved [27–28].

Platform governance also shapes methodological legitimacy. Following increasing restrictions on API access and post–Cambridge Analytica platform controls, researchers have become more dependent on scraped or third-party data sources, raising concerns regarding representativeness, consent, and platform power [29]. These developments highlight that data ethics in diffusion research cannot be separated from broader questions of platform governance.

3.4. Ethical discussions in computational social science

Broader CSS ethics scholarship has addressed issues such as consent, bias, fairness, opacity, and automated decision-making [8–9], [12]. These frameworks provide essential foundations but often focus on general AI systems, predictive analytics, or surveillance capitalism rather than diffusion-specific processes.

Diffusion modeling presents distinct ethical risks because it depends heavily on relational inference, cascade reconstruction, and behavioral prediction. Ethical concerns therefore extend beyond privacy alone to include social exposure, hidden network inference, influence manipulation, and asymmetrical power over visibility [30–32]

Although misinformation studies have partially addressed moral concerns in diffusion contexts [33–34], diffusion modeling itself remains comparatively undertheorized as an ethical object. Existing literature rarely examines how diffusion architectures may reproduce surveillance logics, amplify inequality, or normalize behavioral intervention.

3.5. Gaps in existing literature

Several major gaps remain.

Gap 1: Ethical reflection is rarely integrated directly into diffusion modeling frameworks, which continue to prioritize predictive performance.

Gap 2: Existing big data ethics discussions provide limited guidance for handling relational and temporal trace data central to diffusion research.

Gap 3: Most ethical scholarship is grounded in Western digital infrastructures, with comparatively limited attention to developing digital ecosystems such as Vietnam.

Gap 4: The broader social consequences of diffusion prediction—including behavioral nudging, influence operations, and visibility inequalities—remain insufficiently examined.

Taken together, these gaps justify the need for a diffusion-centered ethical framework that treats information

diffusion modeling not merely as a technical instrument, but as a socio-technical practice embedded within questions of power, governance, and social responsibility.

4. Conceptual framework

To systematically analyze ethical issues in information diffusion modeling, this study proposes a three-layer conceptual framework integrating computational modeling, data ethics, and socio-technical analysis. Rather than introducing a new diffusion model, the framework organizes existing ethical concerns into a structured analytical tool for evaluating risks across the full diffusion research process. The framework consists of three interconnected layers: (1) the data layer, (2) the modeling layer, and (3) the socio-technical impact layer.

This structure treats diffusion modeling as a socio-technical process rather than a purely technical exercise. Ethical risks emerge not only from data collection or algorithmic design, but also from how modeling decisions interact with platform governance, social power, and downstream applications [8]. Accordingly, the framework is designed to support context-sensitive ethical evaluation throughout data collection, model construction, interpretation, and practical deployment.

4.1. Layer 1: The data layer – privacy, consent, and data integrity

The first layer concerns the ethical foundations of data collection and preprocessing. Because diffusion models depend heavily on digital trace data—including timestamps, network edges, and behavioral records—ethical risks often originate before modeling begins [8], [16].

Three core concerns define this layer.

(a) Data Source Transparency

Researchers must clearly document data provenance, collection methods, and platform constraints, particularly when using platform-generated behavioral traces that users may not fully understand or expect to be repurposed [26].

(b) Privacy and Re-identification Risk

Even anonymized diffusion datasets may expose users through structural or temporal signatures [27]–[28]. Because diffusion models frequently reconstruct pathways of interaction, privacy risks often extend beyond individual attributes to relational exposure.

(c) Informed Consent and Contextual Integrity

Publicly accessible data does not automatically imply ethically unrestricted use. Following Nissenbaum's (2010) principle of contextual integrity, ethical legitimacy depends on whether data use aligns with user expectations within the original social context.

Together, these dimensions establish that ethical responsibility begins at the data layer, where methodological choices shape the legitimacy of all subsequent analysis.

4.2. Layer 2: The Modeling Layer – Transparency, Fairness, and Methodological Validity

The second layer addresses ethical issues embedded within modeling assumptions and analytical design. Diffusion models shape how influence, visibility, and collective behavior are interpreted; therefore, ethical concerns arise from abstraction choices as much as from data itself.

(a) Model Transparency and Interpretability

Researchers should clearly communicate assumptions, limitations, and intended applications, particularly when using probabilistic or machine

learning systems whose internal logic may otherwise remain opaque [9].

(b) Bias and Representativeness

Diffusion datasets often reflect unequal platform demographics, participation rates, or network visibility, which may distort cascade predictions or influence estimation [12], [35].

(c) Methodological Validity and Overreach

Predictive performance does not necessarily indicate valid causal inference. Diffusion studies must distinguish between correlation, homophily, and genuine influence, while avoiding unsupported claims or ethically problematic overreach [22].

This layer emphasizes that ethical diffusion modeling requires conceptual clarity alongside technical sophistication.

4.3. Layer 3: The Socio-Technical Impact Layer – Consequences, Accountability, and Governance

The third layer examines how diffusion models shape broader social systems once translated into practical applications such as recommendation systems, behavioral targeting, or content moderation.

(a) Downstream Harms

Diffusion outputs may enable manipulation, surveillance, or exploitative persuasion even when initially developed for benign research purposes [32], [36].

(b) Distributed Responsibility

Ethical accountability extends beyond researchers to include platforms, institutions, funders, and policymakers [9].

(c) Context Adaptation

Ethical governance must be responsive to local socio-technical environments. Developing digital ecosystems such as Vietnam may involve distinct regulatory, cultural, and infrastructural conditions that shape diffusion ethics differently from Western contexts.

This final layer highlights that diffusion modeling is inseparable from broader systems of governance and power.

4.4. Practical Guideline for Ethical Diffusion Modeling

To operationalize the framework, Table 1 translates the three-layer structure into stage-based guidance for research practice.

Table 1: *Ethical Guideline for Diffusion Modeling*

Research Stage	Ethical Risks	Diffusion Modeling Example	Mitigation Strategies
Data Collection	Re-identification, weak consent	Timestamped retweet cascades	Aggregate timestamps, remove identifiers, assess privacy risks
Data Preprocessing	Hidden bias, exclusion	Filtering inactive users or missing nodes	Document filtering criteria, evaluate representativeness
Modeling	Opacity, unrealistic assumptions	Fixed-probability IC/LT models	State assumptions clearly, justify parameters

Research Stage	Ethical Risks	Diffusion Modeling Example	Mitigation Strategies
Interpretation	Overclaiming influence	Treating correlation as causation	Distinguish influence from homophily, report uncertainty
Application	Misuse, manipulation	Influencer targeting or persuasion systems	Limit sensitive outputs, include ethical safeguards

This guideline links ethical principles directly to methodological stages, ensuring that data-layer risks, modeling decisions, and socio-technical consequences remain conceptually aligned.

5. Illustrative case study: Ethical analysis of a diffusion research scenario

To demonstrate the practical applicability of the proposed framework, this section presents an illustrative case study of a diffusion modeling project on a social media platform. Rather than reporting empirical findings, the case simulates a realistic research scenario to show how ethical risks can be identified and mitigated across the full diffusion research pipeline.

Scenario description

A research team investigates how misinformation related to a viral public health issue spreads through a social media platform by analyzing retweet cascades over a two-month period. Using publicly accessible posts, timestamps, and interaction networks, the project seeks to identify influential users and predict cascade growth.

Ethical analysis at the data layer

At the data collection stage, publicly available data does not eliminate ethical risk. Timestamped interactions and network structures may still enable re-identification, while users may not reasonably expect their online behavior to be systematically reconstructed for diffusion analysis.

Applying the proposed framework, the research team mitigates these concerns by removing direct identifiers, aggregating temporal data where possible, documenting data provenance, and assessing re-identification vulnerabilities. Contextual integrity principles further guide decisions about whether data use aligns with likely user expectations.

Ethical analysis at the modeling layer

The team employs an Independent Cascade (IC) model to estimate influence probabilities and forecast diffusion trajectories. At this stage, ethical concerns arise from simplifying assumptions regarding influence behavior, as well as the potential to conflate correlation with genuine causal influence.

To reduce methodological overreach, researchers explicitly state modeling assumptions, justify parameter selection, and conduct sensitivity analyses to evaluate how alternative assumptions affect outcomes. Importantly, findings are framed as probabilistic interpretations rather than definitive causal claims.

Ethical analysis at the socio-technical impact layer

Model outputs include influence rankings and cascade growth predictions, both of which may create downstream risks if used for behavioral targeting, persuasion, or user manipulation. Identifying influential individuals may also expose specific users or communities to unwanted scrutiny.

To mitigate these risks, the study limits disclosure of sensitive outputs, anonymizes influence-related findings, and includes explicit safeguards regarding potential misuse. Responsibility is therefore extended beyond model design to anticipated downstream application.

6. Ethical dimensions of information diffusion modeling

Building on the conceptual framework and illustrative case study, this section synthesizes the major ethical dimensions of information diffusion modeling while applying them to the Vietnamese context. Rather than treating Vietnam merely as a descriptive example, the analysis uses the three-layer framework to demonstrate how ethical risks emerge differently across data practices, modeling assumptions, and socio-technical consequences within a developing digital ecosystem.

Across the literature, four major ethical dimensions consistently emerge: (1) privacy and surveillance, (2) algorithmic bias and representational harms, (3) transparency and epistemic responsibility, and (4) misuse potential and downstream societal impact. These dimensions are interconnected and reflect the broader socio-technical nature of diffusion modeling.

6.1. Privacy, surveillance, and re-identification

Privacy is a foundational ethical concern because diffusion modeling frequently depends on granular behavioral traces such as timestamps, network edges, and interaction histories. Even anonymized datasets may remain vulnerable to re-identification when structural, temporal, or cross-platform data are combined [27–28].

Following Nissenbaum's (2010) concept of contextual integrity, ethical legitimacy depends not simply on whether data are publicly accessible, but on whether their use aligns with user expectations. In diffusion research, this distinction is critical because users may publicly share content without anticipating that their interactions will be systematically modeled to reconstruct influence pathways [26].

Beyond identity exposure, diffusion modeling can also generate forms of soft surveillance by inferring hidden social structures, ideological clustering, or interpersonal influence from digital traces [13]. Ethical privacy concerns therefore extend beyond anonymity to include protection from unintended behavioral and relational inference.

In Vietnam, these risks may be intensified by uneven data governance, fragmented ethical oversight, and uncertain data provenance, highlighting the need for stronger standards of provenance, privacy evaluation, and contextual consent.

6.2. Algorithmic bias and representational harms

Bias in diffusion modeling emerges from data inputs, platform structures, and model assumptions. Social media data often overrepresent highly active or digitally visible populations while underrepresenting less connected groups [35]. As a result, diffusion models may systematically distort influence patterns or exaggerate the visibility of already dominant communities [12].

Platform architectures further complicate this issue. Diffusion data are not neutral reflections of social interaction; they are shaped by recommendation systems, engagement optimization, and algorithmic filtering [19–20]. Consequently, models may incorrectly interpret algorithmically amplified visibility as organic social influence.

Bias may also be embedded directly in modeling assumptions. Standard models such as IC or LT often simplify behavioral heterogeneity, potentially imposing unrealistic or culturally insensitive assumptions about how influence operates.

Within Vietnam's rapidly evolving platform ecosystem, where user behavior, governance, and platform accessibility may differ substantially from Western contexts, these biases require particularly careful interpretation.

6.3. Transparency, interpretability, and epistemic responsibility

Opacity remains a central ethical challenge in diffusion research because methodological choices at multiple stages—data preprocessing, network construction, parameter tuning, and interpretation—can significantly shape conclusions [9].

Diffusion outputs such as influence rankings or cascade probabilities are especially vulnerable to epistemic overreach when correlational patterns are misrepresented as causal influence [22]. Ethical diffusion research therefore requires:

- transparent methodological documentation,
- explicit communication of assumptions and limitations,
- distinction between prediction and causation, and
- clear reporting of uncertainty.

Reproducibility is equally important. Platform restrictions on API access increasingly limit independent validation [29], making transparency in code, preprocessing, and methodological reporting essential to scientific legitimacy.

In Vietnam, where interdisciplinary ethical training and institutional review systems may still be developing, strengthening epistemic responsibility is particularly important.

6.4. Misuse potential, manipulation, and societal impact

Diffusion models can be repurposed beyond research for political persuasion, behavioral targeting, disinformation optimization, or commercial manipulation. Because these models identify influential nodes, susceptible populations, and likely cascade pathways, they may inadvertently support systems of surveillance or behavioral engineering [32], [36].

Potential harms include:

- optimizing persuasive or political messaging,
- strengthening disinformation strategies,
- reinforcing exploitative influencer economies, and
- generating feedback loops that reshape behavior according to predictive systems.

This dimension is particularly important because diffusion models do not merely observe social behavior; they may actively reshape digital ecosystems when integrated into recommendation systems or strategic communication infrastructures [37].

6.5. Implications for ethical diffusion research in Vietnam

Applying the three-layer framework to Vietnam highlights the importance of

contextual adaptation rather than simple adoption of existing international standards.

At the data layer, researchers must address uncertain data provenance, inconsistent privacy protections, and limited governance structures.

At the modeling layer, platform-specific visibility biases and contextual heterogeneity require cautious interpretation and stronger methodological transparency.

At the socio-technical impact layer, local cultural norms, regulatory conditions, and user expectations should shape how privacy, consent, and responsible deployment are understood.

Overall, ethical diffusion research in Vietnam requires both methodological rigor and localized ethical governance.

Summary

The ethical dimensions of information diffusion modeling extend beyond privacy alone to include representational harms, epistemic responsibility, and downstream societal consequences. By integrating these concerns across data, modeling, and socio-technical layers, diffusion research can move beyond narrow technical optimization toward more socially responsible and context-sensitive practice.

7. Ethical challenges in the Vietnamese context

While ethical issues in information diffusion modeling have been widely discussed internationally, their application within Vietnam's rapidly expanding digital environment requires contextual adaptation [14–15]. Vietnam's digital ecosystem is characterized by rapid social media growth, high mobile connectivity, expanding platform participation, and increasing interest in data-driven research. These conditions create important opportunities for Computational Social Science (CSS), but they also generate distinct ethical challenges shaped by local infrastructure, governance, institutional capacity, and cultural norms.

This section identifies four key contextual challenges: (1) data accessibility and research infrastructure, (2) platform-specific dynamics, (3) methodological and institutional capacity, and (4) cultural expectations and user norms.

7.1. Data accessibility and research infrastructure

A major challenge for diffusion research in Vietnam is access to high-quality, ethically sourced, and methodologically reliable datasets. Compared with environments where formalized data repositories or stable research infrastructures are more established, Vietnamese researchers may rely more heavily on platform APIs with unstable access, third-party collection tools, manually assembled datasets, or restricted industry partnerships.

These limitations create two major ethical concerns.

Ethical data sourcing

Restricted API access may encourage reliance on scraping or unofficial collection tools, yet institutional guidance regarding privacy, consent, and platform compliance may remain inconsistent. This places greater ethical responsibility on individual researchers to evaluate sourcing legitimacy.

Incomplete or unrepresentative datasets

Because digital participation varies significantly across geography, age, and platform access, partial datasets may overrepresent highly connected urban populations while excluding less visible communities. Without explicit

acknowledgment of these limitations, diffusion models risk generating misleading conclusions and representational harms.

7.2. Platform-specific dynamics

Vietnam's platform ecosystem includes Facebook, YouTube, TikTok, and Zalo, each with distinct affordances, visibility structures, and communication norms. Ethical diffusion research must therefore account for platform heterogeneity rather than assuming uniform digital environments.

Algorithmic opacity

Limited transparency regarding recommendation or amplification systems complicates interpretation of diffusion outcomes. Researchers may mistakenly interpret algorithmically amplified visibility as organic social influence.

Semi-closed or private communication environments

Platforms such as Zalo may involve less publicly visible interaction structures, increasing the methodological difficulty and ethical sensitivity of studying diffusion within more private or semi-private networks.

These factors reinforce the importance of platform-sensitive interpretation, particularly at the modeling layer of the ethical framework.

7.3. Methodological and institutional capacity

As CSS continues to develop in Vietnam, institutional and educational infrastructures may not yet fully support diffusion-specific ethical oversight.

Limited ethical review structures

Existing ethics committees may be more oriented toward biomedical or traditional human-subject research than toward digital-trace studies involving re-identification, algorithmic inference, or large-scale behavioral data.

Interdisciplinary training gaps

Ethical diffusion research requires expertise in computational methods, privacy, fairness, and social theory. Where interdisciplinary ethics training remains limited, methodological sophistication may outpace ethical preparedness.

This capacity gap increases the importance of developing clearer institutional standards for computational research governance.

7.4. Cultural expectations, user norms, and contextual integrity

Ethical diffusion research in Vietnam must also account for local expectations regarding privacy, visibility, and relational trust.

Although social media content may appear technically public, many users may perceive online participation as socially bounded rather than open to large-scale analytical reconstruction. This aligns with Nissenbaum's concept of contextual integrity: ethical legitimacy depends not solely on data accessibility, but on whether research use aligns with culturally shaped expectations.

In Vietnam, relational trust and community-oriented communication may further complicate assumptions about consent. Users may willingly share content within familiar social networks without anticipating academic, institutional, or large-scale computational analysis.

Accordingly, responsible diffusion research requires greater caution when interpreting public visibility as ethical permission.

7.5. Implications for responsible diffusion research in Vietnam

Several practical implications follow from these challenges.

First, researchers should adopt conservative privacy protections even when using publicly accessible data.

Second, dataset limitations and platform-specific biases should be documented transparently [38].

Third, universities and research institutions should strengthen interdisciplinary training in CSS, data ethics, and socio-technical governance.

Fourth, institutional review systems should expand beyond conventional human-subject ethics to address digital-trace research more directly.

Fifth, collaborations among computational researchers, social scientists, legal scholars, and policymakers can help establish locally appropriate ethical standards.

Overall, responsible diffusion research in Vietnam requires more than importing international ethical norms; it requires adapting them to local digital infrastructures, institutional realities, and cultural expectations. By situating ethical diffusion modeling within Vietnam's specific socio-technical context, researchers can better align methodological innovation with ethical responsibility.

8. Limitations and future research directions

Despite its contributions, this study has several limitations.

First, the proposed framework is primarily conceptual and has not yet been empirically validated across diverse diffusion modeling contexts. Although the illustrative case study demonstrates potential practical applicability, further empirical research is necessary to assess how effectively the framework performs across different datasets, platforms, and methodological settings.

Second, the case study presented here is illustrative rather than based on real-world implementation. As a result, it may not fully capture the complexity, variability, and unpredictability of diffusion processes in dynamic digital environments.

Third, the discussion of Vietnam is based primarily on secondary literature and contextual analysis rather than platform-specific empirical investigation. More localized, data-driven research is needed to examine how ethical challenges manifest across particular Vietnamese platforms, institutional settings, and user communities.

Future research can extend this study in several important directions. Empirical applications of the framework would help test and refine its analytical utility in real diffusion projects. Comparative cross-national and cross-platform studies may also clarify how ethical risks vary across socio-technical environments. Finally, stronger interdisciplinary collaboration among computer science, social science, legal studies, and ethics can further strengthen the methodological rigor and practical relevance of ethical diffusion research.

9. Conclusion

Information diffusion modeling has become a central domain within Computational Social Science (CSS), offering powerful tools for understanding how digital interactions shape collective behavior. As digital platforms expand in scale, influence, and socio-political significance, the ethical dimensions of diffusion modeling are no longer peripheral concerns but foundational issues that shape the legitimacy, methodological validity, and

societal consequences of computational research.

This study synthesized major ethical challenges identified across international scholarship—privacy and surveillance risks, algorithmic bias, epistemic responsibility, and misuse potential—and examined how these concerns acquire additional complexity within Vietnam's rapidly developing digital environment. The analysis demonstrates that ethical diffusion modeling is not simply a matter of regulatory compliance, but a methodological imperative embedded throughout the research process.

Across data collection, modeling, interpretation, and application, diffusion research involves ethical vulnerabilities that can affect both scientific integrity and social impact. Structural privacy risks, platform-induced representational biases, algorithmic opacity, and downstream misuse are not external constraints on diffusion research; they are structural features of contemporary socio-technical inquiry. In emerging contexts such as Vietnam, where data governance, institutional infrastructure, and ethical oversight mechanisms continue to evolve, these challenges become even more significant.

As an analytical and conceptual review, this study does not seek empirical validation. Rather, it aims to synthesize fragmented ethical debates into a coherent framework for diffusion-oriented CSS research while demonstrating how ethical reflection can be integrated into methodological design.

Several priorities emerge for future research.

First, localized ethical guidelines are needed to support digital-trace research in Vietnam and similar developing digital ecosystems.

Second, interdisciplinary education should be strengthened to integrate CSS, data ethics, algorithmic fairness, and socio-technical governance.

Third, privacy-preserving methodologies—including differential privacy, synthetic data generation, and related approaches—should be explored more systematically in diffusion research contexts.

Fourth, transparent and reproducible research practices, including documentation of preprocessing, assumptions, and analytical constraints, are essential for maintaining scientific trust [38].

Fifth, future scholarship should more deeply examine how local cultural norms shape expectations of privacy, visibility, and contextual integrity in digital research environments.

Ultimately, information diffusion modeling offers substantial opportunities for understanding and improving digital ecosystems, but these opportunities are inseparable from ethical responsibility. Integrating ethical reflection into diffusion research can help Computational Social Science produce more transparent, context-sensitive, and socially responsible forms of knowledge. By providing a conceptual foundation for this effort, this study seeks to support future empirical, methodological, and normative research on ethical diffusion modeling both within Vietnam and across broader global contexts

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CÁC VẤN ĐỀ ĐẠO ĐỨC TRONG MÔ HÌNH HÓA SỰ LAN TRUYỀN THÔNG TIN: GÓC NHÌN TỪ KHOA HỌC XÃ HỘI TÍNH TOÁN

Hoàng Tùng
Trường Đại học Đồng Nai
Email: tungaptechbd@gmail.com

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TÓM TẮT

Mô hình hóa quá trình lan truyền thông tin là một hướng tiếp cận quan trọng trong Khoa học xã hội tính toán (Computational Social Science – CSS), giúp làm sáng tỏ cách các tương tác trên nền tảng số định hình hành vi tập thể. Mặc dù các phương pháp mô hình hóa lan truyền ngày càng được ứng dụng rộng rãi, các khía cạnh đạo đức như quyền riêng tư, sự đồng thuận có hiểu biết, tính minh bạch và các thiên lệch tiềm ẩn vẫn chưa được quan tâm đầy đủ, đặc biệt trong các hệ sinh thái số mới nổi như Việt Nam. Bài báo này phân tích các thách thức đạo đức trong nghiên cứu lan truyền thông tin và làm rõ vai trò của chúng trong việc bảo đảm công bằng, trách nhiệm giải trình và liêm chính khoa học. Thông qua việc tổng hợp các nghiên cứu quốc tế và xem xét đặc điểm của bối cảnh số trong nước, bài báo đề xuất các nguyên tắc đạo đức cốt lõi nhằm định hướng thực hành CSS có trách nhiệm, đồng thời hỗ trợ các nghiên cứu tương lai về mô hình hóa lan truyền thông tin được dẫn dắt bởi các cân nhắc đạo đức.

***Từ khóa**: Thiên lệch tiềm ẩn; khoa học xã hội tính toán; đạo đức dữ liệu; lan truyền thông tin; phân tích mạng xã hội*