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From the click race to the citation game: a conceptual exploration of the shift from search engine optimisation to generative engine optimisation

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Abstract

Introduction. Generative artificial intelligence is reshaping how information becomes visible, authoritative, and actionable in digital environments. As generative search systems increasingly replace ranked lists with synthesised responses, established mechanisms of search engine optimisation are being reconfigured.

Method. This study adopts a conceptual–analytic literature review, drawing on research in information retrieval, information behaviour, algorithmic mediation, and generative AI. The literature is synthesised using an abductive framework informed by established information science theory.

Analysis. The paper examines how generative systems restructure informational visibility and authority, introducing generative engine optimisation as a distinct information science construct.

Results. The analysis identifies three mechanisms of generative visibility, namely selection, contribution, and consistency, that distinguish generative optimisation from paradigms grounded in retrieval, such as search engine optimisation and answer engine optimization). It also develops the authority loop model and proposes a framework composed of technical, economic, and cultural dimensions to explain the transition from visibility structured by ranking to visibility grounded in representational synthesis.

Conclusion. By defining generative engine optimisation in both theoretical and operational terms, this study establishes a foundation for future empirical research on generative search, information authority, and information practices shaped by artificial intelligence.

Introduction

Motivation and scope

Search technologies have long played a central role in shaping how information becomes visible, authoritative, and actionable in digital environments. For several decades, search engines that operate through retrieval, most notably web search platforms organized around indexing and ranking, have structured access to information through ranked lists of results, authority signals derived from hyperlinks, and navigation directed by users. These systems have supported a vast ecosystem of optimisation practices, most prominently search engine optimisation (SEO), which seeks to improve content visibility by aligning with ranking algorithms and retrieval logics.

Recent advances in generative artificial intelligence (AI), however, represent a significant transformation in this landscape. Generative search systems, such as assistants built on large language models and search interfaces powered by AI, do not primarily retrieve ranked documents. Instead, they produce synthesised responses by probabilistically combining information from multiple sources. This movement from retrieval to generation fundamentally changes how information is selected, represented, and presented to users.

The motivation for this study lies in the observation that existing conceptual frameworks in information science have not yet fully accounted for this transformation. While professional and technical communities have begun to discuss practices such as *generative engine optimization*, these discussions remain largely atheoretical and practitioner oriented. From an information science perspective, there is a need to examine how generative systems reshape informational visibility, authority, and mediation, and to articulate conceptual tools capable of explaining these changes.

This paper addresses that gap by introducing and developing generative engine optimisation (GEO) as an information science construct. Rather than proposing a set of prescriptive techniques, GEO is conceptualized here as an analytical framework for understanding how information gains visibility and authority within generative AI environments.

Key concepts and definitions

To clarify the scope of the analysis, several key concepts must be defined at the outset.

Search engine optimisation refers to the set of practices intended to improve the visibility of content within search engine results pages generated by retrieval systems. Search engine optimisation operates in systems organized by indexing and ranking and relies on signals such as the quality of metadata, hyperlink structures, domain authority, relevance matching, and measures of user interaction (Jansen, 2018).

Answer engine optimisation emerged with the rise of interfaces that provide direct answers, featured snippets, and search conducted through voice. Answer engine optimisation concentrates on making content easily extractable so that retrieval systems can present concise and authoritative answers without requiring users to navigate entire documents. Despite this change in presentation, it remains grounded in the logic of retrieval and the extraction of information from documents.

Generative engine optimisation, as conceptualized in this study, refers to the informational characteristics, structures, and epistemic signals that increase the likelihood that a source will be selected, weighted, or incorporated into generative AI outputs. Unlike the other optimisation engines, generative engine optimisation operates within probabilistic generative systems that synthesise responses based on latent semantic representations rather than explicit ranking positions.

While terms such as answer engine optimisation and generative engine optimisation have appeared in practitioner discourse, generative engine optimisation is introduced here as an information science construct to analytically capture how generative systems restructure information visibility and authority.

In addition to these optimisation paradigms, the study draws on three foundational concepts from information science:

Information visibility, understood as the conditions under which information becomes accessible and salient within a given system.

Information authority, referring to the mechanisms through which information is perceived as credible, legitimate, or trustworthy.

Sociotechnical mechanisms, which capture how technological systems and social, institutional, and cultural contexts jointly shape information access and interpretation.

Together, these concepts frame the analysis of how generative AI systems restructure informational environments.

Theoretical context

This study is situated within established traditions in information science, particularly research on information behaviour, information retrieval, and algorithmic mediation.

Wilson's (1999) model of information behaviour conceptualizes information seeking as a response to situational needs shaped by cognitive, affective, and contextual factors. Bates's (2002) integrated model similarly emphasizes the iterative interaction between user intentions and system affordances. Both frameworks were developed in retrieval environments, where users navigate documents and progressively resolve uncertainty through comparison and evaluation.

Uncertainty is central to these traditions. Belkin's (1980) anomalous state of knowledge and Kuhlthau's (1991) information search process identify uncertainty as the motivating condition of information seeking. In retrieval systems, uncertainty is addressed through exposure to multiple sources and iterative refinement of understanding.

Generative search systems alter this dynamic. By producing synthesised responses rather than presenting ranked documents, generative engines intervene directly in the resolution of uncertainty. Instead of supporting exploration at the level of individual documents, they provide interpretations generated by the system that may compress or obscure underlying sources. This shift raises questions about how authority is constructed, how credibility is assessed, and how epistemic agency is distributed between users and systems.

The study also draws on sociotechnical perspectives on algorithmic mediation. Research on algorithms as cultural and institutional actors (Introna and Nissenbaum, 2000; Gillespie, 2018) demonstrates that information systems actively shape visibility and legitimacy. Generative systems extend this mediating role by participating directly in knowledge production through semantic representation and probabilistic inference.

Within this framework, information visibility and authority are treated as outcomes of sociotechnical mediation rather than as properties of documents or rankings. Generative systems increasingly structure how relevance and legitimacy are constructed under conditions of uncertainty. This reconfiguration motivates the development of generative engine optimisation (GEO) as a conceptual lens for analysing visibility and authority in generative search environments.

Research questions

Against this theoretical and conceptual backdrop, the study addresses the following research questions:

RQ1. How does the shift from search systems that operate through retrieval to search systems grounded in generative artificial intelligence alter the organization and visibility of online information?

RQ2. How can generative engine optimisation be conceptualized as an information science construct distinct from search engine and answer engine optimisation?

RQ3. What sociotechnical mechanisms characterize the construction of information authority within generative search environments?

Method

Methodological orientation

This study adopts a conceptual–analytic literature review to examine how generative artificial intelligence reshapes information visibility, authority, and optimisation in digital environments. In information science, conceptual reviews are used to clarify emerging constructs, integrate theoretical traditions, and develop explanatory frameworks for evolving phenomena (Bates, 2002; Savolainen, 2007).

Rather than aiming for exhaustive coverage or statistical aggregation, the review prioritizes theoretical integration and conceptual development. Its objective is to articulate generative engine optimisation as an information science construct by synthesizing scholarship in information retrieval, information behaviour, algorithmic mediation, knowledge organization, and generative AI research.

This orientation is appropriate given the rapid evolution of generative search systems and the conceptual immaturity of generative engine optimisation discourse, which remains largely practitioner oriented.

Literature identification and search strategy

Literature was identified through structured searches conducted between October and December 2025 in Scopus, Web of Science, Google Scholar, and the Information Research archive. These sources were selected to ensure disciplinary breadth while maintaining an anchor in information science.

Search queries combined terms related to generative AI, search systems, optimisation practices, and information science constructs, including:

- generative search
- generative artificial intelligence
- large language model*
- AI mediated information retrieval
- algorithmic mediation
- information visibility
- information authority
- search engine optimisation/search engine optimisation
- generative engine optimisation/generative engine optimisation

Backward and forward citation tracking was used to identify foundational theoretical works and recent evaluation studies of generative systems.

Publications were included if they:

- addressed search, retrieval, generative AI, or algorithmic mediation;
- contributed conceptual, theoretical, or framework-oriented insights;
- were peer reviewed or widely cited conference proceedings;

- directly examined generative search evaluation, including selected preprints.

Highly technical papers focused solely on model architecture and practitioner marketing materials without analytical grounding were excluded.
Selection was guided by analytical relevance rather than statistical representativeness, consistent with the conceptual orientation of the study.

Analytical strategy

The analysis follows conceptual synthesis as described by Bates (2002), emphasizing integration across theoretical traditions rather than aggregation of empirical findings. Texts were read iteratively and coded conceptually to identify recurring constructs, tensions, and explanatory gaps related to visibility, authority, and mediation in generative search environments.
Three analytical lenses structured the synthesis:

1. Information behaviour and practices, drawing on Wilson (1999), Belkin (1980), Kuhlthau (1991), and Savolainen (2007), to examine how generative systems reshape uncertainty resolution and epistemic engagement.
2. Algorithmic mediation and sociotechnical power, informed by Introna and Nissenbaum (2000), Gillespie (2018), and Suchman (1995), to analyse how computational systems construct legitimacy and authority.
3. Information retrieval and knowledge organization, focusing on the transition from indexing and ranking to semantic representation and synthesis.

These perspectives informed an abductive process that moved iteratively between theoretical expectations and observed characteristics of generative systems reported in recent evaluation studies (e.g., Liu et al., 2025; Chen et al., 2025; Wang et al., 2024).

Conceptual framework development and abductive reasoning

The conceptual frameworks developed in this study, including the definition of generative engine optimisation, the comparative analysis of search engine, answer engine, and generative engine optimisation, the operational dimensions of generative visibility, and the authority loop model, emerged through abductive reasoning.

Abduction involves generating explanatory constructs by iteratively relating theory to empirical observations. In this study, theoretical insights from information behaviour, algorithmic mediation, legitimacy theory, and knowledge organization were examined alongside reported properties of generative search systems.

Through this process, three recurring mechanisms of generative visibility were identified:

- Selection: whether a source is incorporated into a generated response;
- Contribution: the extent to which incorporated information shapes semantic content;
- Consistency: the stability of inclusion and influence across queries and systems.

These mechanisms form the analytical core of generative engine optimisation and structure the operationalization presented in later sections.

Transparency of the review process

To ensure transparency, the process of identifying and screening the literature is documented through a flow diagram presented in the Appendix. The diagram reports the number of records identified, screened, and included, providing a clear account of how the review was conducted.

In line with the conceptual and analytic orientation of this study, this framework is used as a tool for documentation rather than as a claim of systematic exhaustiveness. The selection of

literature was guided by analytical relevance and theoretical contribution to the research questions.

Recent systematic reviews following PRISMA guidelines have mapped generative artificial intelligence across diverse domains of application (e.g., Batista et al., 2024; Lenart, 2025; Surbakti, 2025). By contrast, the present study adopts a conceptual and analytic approach to theorize generative information visibility and authority in search environments.

Methodological limitations

This study adopts a conceptual and analytic review design and does not aim to provide exhaustive coverage of research on generative artificial intelligence. The selection of literature was guided by theoretical relevance to generative visibility, authority, and search mediation rather than by quantitative distribution across journals, countries, or authors.

As with all conceptual syntheses, decisions regarding inclusion involve interpretive judgment. Although this approach supports theoretical integration and the development of a coherent framework, future empirical and bibliometric studies may test, refine, and extend the constructs proposed here.

Literature review

This literature review serves both as theoretical grounding and as a core component of the conceptual analysis. It situates generative search within established information science traditions, information retrieval, algorithmic mediation, information behaviour, and knowledge organization, while synthesizing how these literatures conceptualize visibility, authority, and mediation in evolving search environments.

Rather than exhaustively cataloguing publications on generative artificial intelligence, the review identifies the theoretical strands necessary to articulate generative engine optimisation (GEO) as a construct within information science. It therefore serves three functions:

1. Situating generative search within models of visibility grounded in retrieval,
2. Explaining authority through sociotechnical mediation,
3. Examining how generative systems reshape uncertainty and processes of sensemaking.

Information retrieval, ranking and digital visibility

Research in information retrieval has long examined how indexing, ranking, and the estimation of relevance structure informational visibility. From early Boolean retrieval models to probabilistic approaches and models based on learning to rank, technical developments have shaped not only system performance but also public access to knowledge.

With the rise of web search, ranking mechanisms grounded in hyperlinks operationalized authority as a form of network endorsement. Introna and Nissenbaum (2000) show that ranking is never neutral, as it embeds political and institutional values within search infrastructures. Visibility therefore became a sociotechnical outcome rather than a purely technical function.

Search engine optimisation emerged in alignment with these mechanisms, optimizing content through metadata, hyperlink structures, and engagement signals (Diaz, 2016; Jansen, 2009). More recently, hybrid retrieval–generation architectures indicate that traditional ranking signals are increasingly supplemented by semantic inference (Nogueira et al., 2020; Lewis et al., 2020), foreshadowing generative visibility regimes.

Generative search and the representational mediation

Generative search systems depart from ranked retrieval by producing synthesised responses through large language models. Architectures that combine retrieval with language generation integrate signals from retrieved documents with probabilistic text generation (Izacard and Grave,

2021; Lewis et al., 2020), shifting visibility from positional ranking to inclusion within synthesised representations.

Recent benchmarking studies highlight this transformation. Liu et al. (2025) introduce a benchmark for generative engine optimisation to measure inclusion and robustness in generated outputs. Chen et al. (2025) demonstrate variation across engines in generative visibility and information freshness, while Wang et al. (2024) identify performance differences across query intents. Together, these studies indicate that visibility in generative systems depends on latent semantic representations and inference routines rather than on observable rank positions.

This transition necessitates new conceptual tools capable of explaining representational visibility, one aim of generative engine optimisation.

Algorithmic mediation and authority construction

Research on algorithmic mediation emphasizes that platforms shape legitimacy through infrastructural design (Gillespie, 2014; Gillespie, 2018). Traditional search systems distribute symbolic capital unevenly, reinforcing institutional hierarchies (Bourdieu, 1986).

Generative systems intensify this role by synthesizing knowledge directly. Authority becomes embedded within outputs that may obscure source diversity or provenance (Diakopoulos, 2019). Legitimacy theory (Suchman, 1995) clarifies how repeated validation stabilizes authority; in generative environments, recursive inclusion may amplify already dominant sources.

Concerns about bias and opacity reinforce these dynamics. Generative models reflect training data inequalities (Bender et al., 2021; Birhane et al., 2021), raising questions of epistemic justice. From this perspective, GEO captures not only technical optimisation but sociotechnical authority construction.

Information behaviour and uncertainty

Information behaviour research situates seeking within cognitive and contextual conditions (Wilson, 1999; Bates, 2002). Uncertainty is central: Belkin's (1980) anomalous state of knowledge and Kuhlthau's (1991) model describe iterative resolution through comparison and exploration.

Generative systems alter this process. By producing synthesised answers, they intervene directly in the resolution of uncertainty and may reduce evaluation at the level of individual documents. Empirical research suggests that users may overtrust coherent content generated by artificial intelligence (Longoni et al., 2019; Metzger and Flanagin, 2015).

Perspectives on information practices (Savolainen, 2007) emphasize that such shifts are embedded in broader sociocultural contexts. Generative engine optimisation intersects with these dynamics by shaping which information becomes epistemically available during processes of sensemaking mediated by artificial intelligence.

Knowledge organization and generative legibility

Knowledge organization research demonstrates that classification and metadata structure informational access (Bowker and Star, 1999; Hjørland, 2002). While generative systems rely on implicit semantic embeddings rather than explicit indexing, structured and conceptually coherent content remains more generatively legible (Chen et al., 2025; Liu et al., 2025).

Floridi (2010) argues that information systems increasingly shape epistemic environments themselves. Generative systems extend this role by actively producing representations. GEO therefore operates at the intersection of knowledge organization and machine interpretability.

Positioning generative engine optimisation within existing review literature

Recent systematic reviews have examined generative artificial intelligence across multiple domains, following the reporting standards established in PRISMA 2020 (Page et al., 2021). Ethical syntheses address issues of bias mitigation and governance (Afreen et al., 2025; Surbakti, 2025), while domain specific reviews focus on higher education (Batista et al., 2024), requirements engineering (Cheng et al., 2025), recommender systems (Ayemowa et al., 2024), and organizational learning (Lenart, 2025).

Although these studies map applications and associated risks, none theorize how generative systems reorganize information visibility and authority within search environments. This gap motivates the present conceptualization of generative engine optimisation as a framework within information science that focuses specifically on mediation in generative search systems.

Synthesis

Across these literatures, three patterns emerge:

1. Generative systems replace positional visibility with representational inclusion.
2. Algorithmic mediation becomes more opaque and more constitutive of authority.
3. The resolution of uncertainty shifts from navigation directed by users to synthesis produced by artificial intelligence.

These dynamics establish the need for a framework capable of analysing generative visibility and authority. The following sections develop generative engine optimisation in response to this theoretical gap.

Conceptual definition of generative engine optimisation

Generative engine optimisation emerges in response to a structural transformation in how information becomes visible and authoritative within search environments driven by artificial intelligence. While search engine optimisation and answer engine optimisation developed within systems grounded in retrieval, generative engine optimisation addresses environments in which large language models produce synthesised responses through probabilistic inference rather than through ranking or the extraction of snippets.

In this study, generative engine optimisation is conceptualised as a construct within information science rather than as a prescriptive optimisation strategy. It offers an analytical framework for explaining how information attains visibility and authority within generative systems. Its theoretical grounding rests on its capacity to capture a form of informational mediation that cannot be adequately described by models of ranking, relevance, or extractability derived from retrieval systems.

Defining generative engine optimization

Generative engine optimisation is introduced as a theoretically grounded information science construct rather than a reformulation of search engine optimisation or answer engine optimisation. Drawing on research in information retrieval (Introna and Nissenbaum, 2000; Jansen, 2009), algorithmic mediation (Gillespie, 2018; Diakopoulos, 2019), information behaviour (Belkin, 1980; Kuhlthau, 1991; Wilson, 1999; Bates, 2002; Savolainen, 2007), and recent studies of generative search systems (Liu et al., 2025; Chen et al., 2025; Wang et al., 2024; Zhang et al., 2025), generative engine optimisation refers to the informational characteristics and epistemic signals that increase the likelihood that a source will be selected, weighted, or incorporated into generative AI outputs.

Unlike optimisation grounded in retrieval, which seeks to improve the position of documents within ranked interfaces, generative engine optimisation addresses inclusion within synthesised

representations. Visibility in generative systems is therefore not primarily positional or extractive but representational: information becomes influential to the extent that it shapes the semantic content of generated outputs.

This definition reflects an authorial conceptual synthesis integrating established information science theory with emerging evidence on generative search behaviour.

Generative engine optimisation and the limits of optimisation grounded in retrieval

Retrieval paradigms of optimisation assume that visibility is structured through indexing and ranking. In such systems, authority is inferred from observable signals, including hyperlink structures, domain reputation, and relevance scores (Introna and Nissenbaum, 2000). Search enginee and answer engine optimisation operate within this logic by aligning content with mechanisms of ranking and extractability.

Generative systems operate differently. Large language models produce responses through latent semantic representations and probabilistic inference rather than through deterministic ranking. Visibility depends on compatibility with model embeddings and training data priors rather than on the position of a document in a results list.

From the perspective of information science, this shift represents a movement from mediation grounded in indexing to mediation grounded in representation. Generative engine optimisation is conceptually distinct because it addresses this representational layer, where informational authority is embedded within synthesised outputs rather than displayed through ranked presentation.

Information behaviour and the epistemic foundations of generative engine optimisation

Generative engine optimisation is theoretically grounded in information behaviour scholarship that emphasizes uncertainty, context, and system affordances (Wilson, 1999; Bates, 2002). Belkin's (1980) anomalous state of knowledge and Kuhlthau's (1991) model conceptualize information seeking as iterative uncertainty resolution.

Generative systems alter this process by producing synthesised answers directly, which may reduce comparison at the level of individual documents. Authority becomes embedded within representations generated by the system rather than inferred from observable cues associated with ranking. Generative engine optimisation therefore intersects with research on information behaviour by conceptualizing optimisation as the shaping of informational conditions under which generative systems resolve uncertainty on behalf of users.

Optimization, in this sense, becomes a form of epistemic mediation.

Knowledge organization, interpretability, and generative legibility

Knowledge organization research further grounds generative engine optimisation. Classification, metadata, and conceptual structure shape informational order and access (Bowker and Star, 1999; Hjørland, 2002). While generative systems rely on implicit embeddings rather than explicit indexing, structured and conceptually coherent content remains more likely to be incorporated into generative outputs (Liu et al., 2025; Chen et al., 2025).

This introduces the notion of generative legibility: information must be interpretable to both human audiences and machine inference processes. Floridi (2010) argues that information systems increasingly shape epistemic environments themselves. Generative engines extend this role by actively producing knowledge representations, making semantic coherence and

conceptual clarity central to visibility and, therefore, operate at the intersection of knowledge organization and machine interpretability

Algorithmic mediation and sociotechnical authority

Generative engine optimisation must also be understood as a sociotechnical construct. Research on algorithmic mediation demonstrates that digital systems actively shape legitimacy and informational hierarchies (Gillespie, 2018). Generative systems intensify this mediating role by embedding authority within synthesised outputs.

Suchman's (1995) theory of legitimacy clarifies how authority becomes stabilized through repeated recognition. In generative environments, information that is consistently selected and synthesised may accrue recursive legitimacy, increasing its likelihood of future inclusion.

Generative engine optimisation captures these recursive dynamics of representational authority and extends earlier critiques of power structured through ranking (Introna and Nissenbaum, 2000) into the domain of generative systems.

Generative engine optimisation as a distinct optimisation regime

Taken together, these theoretical foundations establish Generative engine optimisation as a distinct optimisation regime characterised by:

- Probabilistic selection rather than deterministic ranking
- Representational visibility rather than positional visibility
- Authority embedded within synthesis rather than displayed through rank
- Recursive reinforcement through repeated generative inclusion

While search engine and answer engine optimisation remain relevant in hybrid systems, generative engine optimisation addresses a qualitatively different mediation regime. It reflects a transformation in how information is interpreted, weighted, and reconstructed by generative systems.

By grounding generative engine optimisation in theories of information behaviour, knowledge organization, and algorithmic mediation, this study establishes it as an analytically necessary construct for examining visibility and authority in information environments shaped by artificial intelligence.

Comparing search engine optimisation, answer engine optimisation and generative engine optimisation

To clarify the conceptual distinctiveness of generative engine optimisation, this section compares search engine, answer engine, and generative engine optimisation across their underlying logics of visibility, authority, and mediation. This comparison represents an original analytical synthesis informed by research on information retrieval, algorithmic mediation, and generative search systems (Gillespie, 2018; Introna and Nissenbaum, 2000; Liu et al., 2025; Marchionini, 1995).

Search engine optimisation operates within systems grounded in retrieval in which visibility is constructed through ranked lists of documents. Authority is inferred from signals such as hyperlinks, domain reputation, and relevance scoring, and users resolve uncertainty through navigation and comparison (Jansen, 2009; Marchionini, 1995). Optimization strategies therefore focus on position within rankings and rates at which users click on results.

Answer engine optimisation emerged with interfaces that provide direct answers and featured snippets. Although it reduces the need for document navigation, it remains grounded in the logic

of retrieval and information extraction (Diaz, 2016; Haider and Sundin, 2019). Authority becomes concentrated in units of answers considered extractable and appropriate for immediate display.

Generative engine optimisation differs conceptually by operating within probabilistic generative systems that produce synthesised responses rather than retrieve or extract documents. Visibility becomes representational rather than positional: information gains influence through its inclusion and relative weighting within generated outputs, independent of ranking position or explicit citation (Floridi, 2010; Gillespie, 2018). Empirical studies show that inclusion and semantic influence vary across engines and types of queries, reflecting inference routines specific to each model rather than traditional signals associated with ranking (Chen et al., 2025; Liu et al., 2025).

From an information science perspective, this transition reconfigures how authority is constructed and perceived. Whereas search engine and answer engine optimisation rely on observable ranking or extraction cues, generative systems embed authority within synthesised representations that may obscure provenance and diversity (Bowker and Star, 1999; Metzger and Flanagin, 2015). GEO therefore captures a distinct mediation regime centred on representational inclusion.

Table 1 summarizes these conceptual distinctions across optimisation regimes. The comparison is not intended as an empirical taxonomy, but as an analytical framework that clarifies how evolving search technologies restructure informational visibility, authority, and uncertainty resolution.

Dimension	Search engine optimisation	Answer engine optimisation	Generative engine optimisation
Search paradigm	Based on retrieval	Based on retrieval (direct answers)	Generative, probabilistic synthesis
Unit of visibility	Ranked document position	Extracted answer/snippet	Representational inclusion in generated output
Authority signals	Links, domain reputation, relevance scores	Extractability, structured answers	Semantic alignment, epistemic coherence, training priors
User interaction	Navigation and comparison	Reduced navigation	Delegated interpretation
Optimization focus	Ranking and clicks	Extractability and answer suitability	Selection, contribution, and consistency
Epistemic implication	Visibility through navigability	Visibility through extraction	Visibility through representational influence

Table 1. Conceptual comparison of search engine, answer engine, and generative engine optimisation. This table represents an original conceptual synthesis informed by research on information retrieval, algorithmic mediation, and generative search systems (Chen et al., 2025; Gillespie, 2018; Introna and Nissenbaum, 2000; Jansen, 2009; Liu et al., 2025; Marchionini, 1995)

Search engine optimisation

Search engine optimisation developed alongside architectures for indexing and ranking at large scale. Documents are retrieved and ordered according to signals of relevance and authority, such as keyword matching, hyperlink structures, the quality of metadata, and measures of user engagement (Diaz, 2016; Jansen, 2009).

Visibility in this regime is positional. Documents placed higher in ranking lists receive disproportionate attention, and authority becomes embedded within the infrastructure of

ranking itself (Introna and Nissenbaum, 2000). Evaluation metrics such as impressions, average position, and the rate at which users click on results reflect this navigational logic.

Answer engine optimisation

Answer engine optimisation responds to interfaces that provide direct answers, including featured snippets and search conducted through voice. Although it remains grounded in retrieval systems, it shifts optimisation toward structured units of content that can be easily extracted (Jansen, 2009; Vaidhyanathan, 2011). Visibility is achieved through extractive mediation: systems retrieve documents but display selected fragments as authoritative answers. Despite the reduction in navigation, AEO remains anchored in architectures organized around ranking.

Generative engine optimisation

Generative engine optimisation addresses search systems that produce synthesised responses using large language models and architectures that combine retrieval with language generation (Lewis et al., 2020; Liu et al., 2025).

In generative environments, visibility is not positional. Information becomes influential through its inclusion and semantic contribution within synthesised outputs. Inclusion and influence may diverge, as sources can shape responses even when they are not explicitly cited (Chen et al., 2025).

Authority is mediated through epistemic signals such as semantic coherence, credibility, and alignment with model priors (Floridi, 2010; Gillespie, 2018). From an information science standpoint, generative engine optimisation reflects a transition from navigational visibility to representational influence.

Comparative analytical dimensions

Table 2 summarizes the conceptual distinctions between the engine optimisation types across five analytical dimensions. These dimensions are derived from established retrieval theory (Marchionini, 1995; Jansen, 2009), research on algorithmic mediation (Introna and Nissenbaum, 2000; Gillespie, 2018), and recent empirical studies of generative search systems (Liu et al., 2025; Chen et al., 2025; Wang et al., 2024).

Dimension	Search engine optimisation	Answer engine optimisation	Generative engine optimisation
Primary goal	Improve ranking and traffic	Provide extractable answers	Achieve inclusion and influence in generative responses
Optimization target	Indexing and ranking algorithms	Snippet extraction mechanisms	Generative model interpretation and synthesis
Visibility mechanism	Positional ranking	Extractive presentation	Representational inclusion
Authority signals	Backlinks, domain authority, engagement	Factual precision, schema, formatting	Credibility, semantic coherence, epistemic clarity
User interaction	Click-through navigation	Reduced navigation	Zero-click synthesised responses
Evaluation metrics	Rank, impressions, CTR	Snippet capture, answer accuracy	Inclusion rate, influence score, cross-engine consistency

Table 2. Conceptual distinctions between SEO, AEO, and GEO. Table 2 is an analytical synthesis developed by the author, informed by Chen et al. (2025); Gillespie (2018); Introna and Nissenbaum (2000); Jansen (2009); Liu et al. (2025).

Implications of the comparison

Two theoretical implications follow.

First, generative engine optimisation cannot be reduced to an extension of search engine or answer engine optimisation. Although all three address visibility, they operate within different mediation regimes: ranking based on retrieval, extractive presentation, and generative synthesis.

Second, the shift from positional to representational visibility alters how authority is constructed and evaluated. In generative systems, authority is embedded within opaque inference processes rather than observable ranking structures, raising challenges for transparency and epistemic accountability (Diakopoulos, 2019; Haider and Sundin, 2019).

These distinctions justify generative engine optimisation as a separate analytical construct and prepare the ground for its operationalization.

Operationalizing generative engine optimisation

The operationalization of generative engine optimisation builds on the abductive process described earlier. The guiding principles, selection, contribution, and consistency, emerged through iterative comparison of information science theory with empirical studies of generative search systems. They describe recurring mechanisms of generative visibility rather than prescriptive tactics.

Selection refers to whether a source is incorporated into a generative response. Contribution captures the extent to which incorporated information shapes semantic content. Consistency denotes the stability of selection and influence across queries and systems. Together, these principles shift visibility from positional ranking to representational inclusion.

The following subsections use these principles to structure emerging evaluative approaches in generative search research.

Guiding principles of generative visibility

Selection. Replaces ranking as the primary visibility threshold in generative systems. A source is either incorporated into a synthesised response or excluded. Empirical studies show that selection is influenced by semantic relevance, conceptual clarity, credibility signals, and contextual alignment (Chen et al., 2025; Liu et al., 2025). In information science terms, selection functions as algorithmic gatekeeping (Gillespie, 2018), determining which information becomes epistemically available.

Contribution. Refers to the degree to which selected information shapes the meaning and framing of a generated response. Inclusion alone does not guarantee influence. Zhang et al. (2025) demonstrate that semantic contribution may diverge from citation frequency, indicating that authority in generative systems is not reducible to explicit attribution. Contribution therefore reflects epistemic authority: the capacity of information to structure interpretation within synthesised outputs.

Consistency. Captures the stability of selection and contribution across differences in query phrasing, user intent, language, and platform architecture. Chen et al. (2025) and Wang et al. (2024) document substantial variation across engines and across types of intent, highlighting that generative visibility is sensitive to contextual and infrastructural factors. Consistency reflects the durability of informational authority within heterogeneous environments shaped by artificial intelligence.

Inclusion rate: measuring generative selection

Inclusion rate operationalizes selection by measuring how frequently a source appears in generative outputs across repeated queries (Liu et al., 2025). At scale, inclusion becomes probabilistic rather than positional. It indicates whether information crosses the selection threshold within a model's representational logic.

From an information science perspective, inclusion rate reflects baseline generative visibility and epistemic admissibility.

Influence score: assessing epistemic contribution

Influence score operationalizes contribution by estimating the semantic impact of a source on a generated response. Approaches such as semantic similarity analysis and perturbation testing approximate this effect (Zhang et al., 2025).

Because generative systems may internalize information without explicit citation, influence score captures a deeper dimension of authority than citation metrics alone (Floridi, 2010).

Inclusion and contribution analysed by type of intent

Generative responses vary across informational, procedural, comparative, and evaluative queries (Wang et al., 2024). Assessing inclusion and influence in relation to user intent reveals patterns of generative visibility that depend on context.

This aligns with theory on information behaviour, which emphasizes uncertainty related to specific tasks and situational needs (Belkin, 1980; Kuhlthau, 1991). GEO must therefore be assessed in relation to differentiated information needs.

Sensitivity and system variation across different engines

Generative platforms differ in training data, recency integration, and retrieval augmentation strategies. Chen et al. (2025) demonstrate substantial variation for identical queries across different engines.

Sensitivity across different engines measures whether generative visibility is stable across platforms. High variation indicates infrastructural contingency, reinforcing Gillespie's (2018) argument that platforms instantiate distinct epistemic values.

Linguistic and paraphrase robustness

Minor variations in phrasing can alter generative outputs (Liu et al., 2025; Chen et al., 2025). Linguistic robustness assesses whether a source maintains inclusion and influence across paraphrased or translated queries.

Robustness signals conceptual clarity and stable semantic alignment within model embeddings.

Summary of operational dimensions

Table 3 summarizes the operational dimensions of GEO and their theoretical grounding.

Dimension	Definition	Primary Sources	Information Science Relevance
Inclusion rate	Frequency of source appearance	Chen et al. (2025); Liu et al. (2025)	Baseline generative visibility
Influence score	Degree of semantic contribution	Zhang et al. (2025)	Epistemic authority
Intent-stratified evaluation	Variation by query intent	Wang et al. (2024)	Task and uncertainty sensitive visibility
Sensitivity across different engines	Variation across systems	Chen et al. (2025)	Sociotechnical mediation

Linguistic robustness	Stability under paraphrase	Liu et al. (2025)	Conceptual clarity

Table 3. Operational dimensions of generative engine optimization. Table 3 is an analytical synthesis developed by the author, informed by recent generative search evaluation literature.

From metrics to sociotechnical analysis

These dimensions extend beyond measurement. Generative systems tend to amplify sources that are institutionally recognized, structurally coherent, and aligned with dominant epistemic frameworks. As selection becomes recursive, inclusion may reinforce symbolic capital (Bourdieu, 1986; Suchman, 1995).

Ecosystemic considerations of generative engine optimisation adoption

The operational dimensions also reveal broader eco-systemic implications.

Visibility concentration. Recursive inclusion may amplify already dominant sources (Bourdieu, 1986; Introna and Nissenbaum, 2000), marginalizing alternative voices.

Algorithmic bias. Generative models reflect training data inequalities (Bender et al., 2021; Birhane et al., 2021), potentially favouring actors with greater structural and material resources.

Opacity. Generative inclusion and influence are mediated through inference processes that are often opaque, reducing transparency when compared with systems organized around ranking (Diakopoulos, 2019; Gillespie, 2018).

Economic displacement. Synthesized responses may reduce traffic to original sources, redistributing value toward platform owners (Simon, 2025).

Normative pressure. Incentives to optimise for machine interpretability may encourage homogenised knowledge structures.

These eco-systemic considerations are summarised in table 4 and underscore the need to treat GEO not merely as an analytical construct, but as a sociotechnical phenomenon with implications for equity, accountability, and knowledge governance.

Risk	Description	Implications
Visibility concentration	Recursive amplification of selected sources	Marginalization of smaller or alternative voices
Algorithmic bias	Training data and institutional bias	Unequal representation across regions and languages
Opacity of selection	Limited transparency in generative inference	Reduced accountability and interpretability
Economic displacement	Reduced traffic to original sources	Sustainability challenges for content producers
Normative pressure	Incentives to align with model preferences	Homogenization of knowledge structures

Table 4. Eco-systemic risks and implications of generative engine optimisation adoption. Table 4 is an analytical synthesis developed by the author, informed by Bender et al. (2021); Birhane et al. (2021); Bourdieu (1986); Diakopoulos (2019); Gillespie (2018); Introna and Nissenbaum (2000); Simon (2025).

Discussion

This discussion integrates the conceptual, comparative, and operational analyses presented earlier and clarifies how they culminate in the proposed models. The authority loop and the model of the transition from search engine to generative engine optimisation, structured across technical, economic, and cultural dimensions, are synthetic outcomes of the abductive process

described in the method and developed throughout the analytical sections. The following subsections retrace this reasoning in relation to the research questions.

From visibility based on retrieval to generative synthesis (RQ1)

RQ1 asked how the transition from search systems grounded in retrieval to search systems based on generative artificial intelligence alters the organization and visibility of information. The analysis shows a structural shift from visibility shaped by indexing and ranking to visibility grounded in representation and synthesis.

In retrieval environments, ranking algorithms order documents and users resolve uncertainty through navigation and comparison (Marchionini, 1995). In generative systems, visibility is mediated through semantic representation and probabilistic inference. Users increasingly encounter synthesised outputs rather than ranked lists, and interpretive labour is partially delegated to the system.

This shift reconfigures visibility from navigational prominence to representational inclusion. Traditional optimisation strategies tied to rank position become less directly applicable, motivating the conceptual development of generative engine optimisation.

The paper's title, from the click race to the citation game, captures this transformation. The "click race" refers to competition grounded in retrieval for rank and traffic. The *citation game* denotes generative environments in which informational influence depends on selection, incorporation, and representational alignment within synthesised outputs. Authority is thus increasingly secured through epistemic inclusion rather than user clicks.

Reconfiguring authority in generative environments (RQ3)

RQ3 addressed how authority is constructed in generative search systems. In systems grounded in retrieval, authority is inferred from observable signals such as ranking position and hyperlink structures. Generative systems embed authority within synthesised outputs, often with limited transparency regarding provenance.

The operational principles of generative engine optimisation, selection, contribution, and consistency, clarify this shift. Authority depends on whether information is incorporated into generated responses, how strongly it shapes semantic content, and how consistently it appears across contexts. Visibility and legitimacy are therefore mediated through representational alignment with model embeddings and inference routines.

This dynamic extends prior research on algorithmic mediation (Gillespie, 2018), emphasizing that platforms shape informational hierarchies through infrastructural design. In generative systems, mediation is intensified: systems do not merely order information but synthesise it.

The authority loop model

The authority loop model (Figure 1) synthesises insights from the conceptual definition of generative engine optimisation, the comparative analysis, and the operational dimensions.

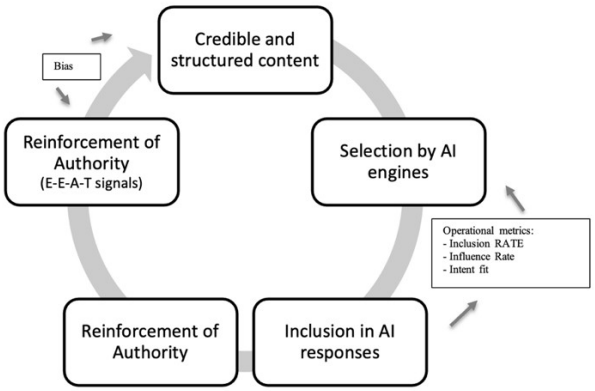

Figure 1. The authority loop in Generative engine optimization. The authority loop model illustrating how credibility, interpretability, and structural clarity recursively reinforce generative visibility and epistemic authority.

Information that is structurally coherent, semantically explicit, and institutionally recognized is more likely to be selected in generative outputs. Once incorporated, it gains visibility and perceived credibility. This enhanced legitimacy increases the likelihood of future inclusion, reinforcing representational alignment within model embeddings.

This recursive process reflects Suchman's (1995) theory of legitimacy and Bowker and Star's (1999) insight that classificatory systems stabilize dominant knowledge structures. In generative environments, classification operates through embeddings rather than explicit taxonomies, yet repeated inclusion similarly consolidates authority.

Floridi's (2010) account of information systems as infrastructures that shape informational environments further contextualizes this dynamic: generative systems actively participate in the construction of epistemic reality. The authority loop therefore clarifies how authority is recursively produced and normalized within environments shaped by AI.

GEO as a distinct information science construct (RQ2)

RQ2 asked how generative engine optimisation can be conceptualized as distinct from search engine and answer engine. The analysis demonstrates that generative engine optimisation constitutes a coherent construct grounded in information science theory.

First, generative engine optimisation differs in its unit of visibility. Whereas search engine and answer engine optimisation address positional or extractive visibility in retrieval systems, generative engine optimisation addresses representational visibility in generative synthesis.

Second, its operational dimensions, selection, contribution, and consistency, are specific to generative mediation and cannot be meaningfully applied to ranked retrieval systems. Metrics such as inclusion rate and influence score presuppose probabilistic synthesis.

Third, generative engine optimisation integrates insights from information behaviour, knowledge organization, and algorithmic mediation to explain how generative systems reshape uncertainty resolution and authority construction. It therefore extends, rather than replaces, established theoretical traditions.

Together, these features justify generative engine optimisation as an analytically necessary construct within contemporary information science.

The multiple layers of the search engine optimisation–generative engine optimisation transition

The model composed of multiple layers integrates the technical, economic, and cultural implications identified throughout the analysis.

At the **technical layer**, the transition involves movement from indexing and ranking toward semantic representation and probabilistic synthesis.

At the **economic layer**, generative interfaces may reduce direct traffic to original sources and redistribute value toward platform providers (Simon, 2025). Visibility becomes a representational resource rather than a navigable position.

At the **cultural layer**, generative systems reshape information practices by encouraging hybrid human–AI sensemaking. Users increasingly rely on synthesised outputs, altering norms of verification, trust, and epistemic engagement.

Together, these layers illustrate that generative engine optimisation reflects a broader sociotechnical transformation in knowledge production and mediation.

Implications for information science

These findings have several implications. First, foundational concepts such as visibility, authority, and relevance require reconsideration under generative mediation. Second, the study underscores the importance of sociotechnical analysis in understanding search systems driven by AI.

For institutions such as libraries, archives, and public agencies, maintaining visibility in generative environments may require attention to semantic clarity, structural coherence, and transparent knowledge organization. For researchers, generative engine optimisation offers a framework for empirically examining generative authority, trust, and epistemic governance.

Contributions

This study advances information science by developing a conceptual and analytical framework for understanding how generative artificial intelligence reshapes information visibility and authority.

First, it introduces generative engine optimisation as a distinct information science construct. By grounding generative engine optimisation in information retrieval, information behaviour, knowledge organization, and algorithmic mediation, the study moves beyond practitioner discourse and conceptualizes visibility in generative search environments as representational rather than positional or extractive.

Second, it provides a comparative analytical framework that clarifies the transition from visibility grounded in retrieval to visibility produced through generative systems. By systematically contrasting search engine, answer engine and generative engine optimisation across mechanisms of visibility, signals of authority, forms of user interaction, and evaluation metrics, the paper shows how generative systems reshape assumptions about relevance and authority that were structured around ranking.

Third, it operationalizes generative engine optimisation through three analytically derived mechanisms: selection, contribution, and consistency. Related evaluative dimensions, including inclusion rate, influence score, analysis differentiated by user intent, and sensitivity across different engines, translate conceptual claims into phenomena that can be examined empirically without reducing generative engine optimisation to prescriptive optimisation techniques.

Fourth, the study develops the authority loop model to explain how generative systems recursively reinforce credibility and epistemic alignment. Integrating legitimacy theory and research on algorithmic mediation, the model clarifies how generative inclusion stabilizes informational hierarchies.

Finally, it proposes a conceptual model of the transition from search engine optimisation to generative engine optimisation structured across technical, economic, and cultural dimensions. By distinguishing these dimensions, the paper situates generative visibility within broader transformations of information practices, platform economies, and processes of sensemaking shaped by artificial intelligence.

Collectively, these contributions extend theory in information science to account for generative mediation and establish generative engine optimisation as a coherent analytical lens for examining visibility and authority in environments shaped by artificial intelligence.

Conclusion

This study examined how generative artificial intelligence reshapes the mechanisms through which information becomes visible, authoritative, and actionable in digital environments. Building on theories in information retrieval, information behaviour, knowledge organization, and algorithmic mediation, it introduced generative engine optimisation as a conceptual framework for analysing visibility in generative search systems.

In response to RQ1, the analysis demonstrated that generative search replaces visibility shaped by indexing and ranking with visibility grounded in representation and synthesis. Users increasingly encounter responses produced by the system rather than ranked lists, shifting the resolution of uncertainty from navigation and comparison toward synthesis carried out by artificial intelligence.

Addressing RQ2, the study established generative engine optimisation as a distinct construct within information science. Unlike search engine and answer engine optimisation, which operate within architectures grounded in retrieval, generative engine optimisation captures a regime of mediation in which informational authority is embedded within synthesised outputs. The conceptual definition, comparative framework, and operational dimensions developed here show that generative visibility requires analytical tools that extend beyond models centred on ranking.

Regarding RQ3, the study identified sociotechnical mechanisms through which authority is constructed in generative environments. The authority loop model explains how credibility, interpretability, and structural coherence are recursively reinforced through generative inclusion, stabilizing particular informational structures over time.

Taken together, these findings indicate that generative systems do not merely retrieve information but actively synthesise and normalize representations of knowledge. This transformation has implications for visibility, equity, accountability, and trust within digital information ecosystems.

For information science, the results underscore the need to extend foundational concepts of visibility, authority, and relevance to account for synthesis mediated by AI. For institutions such as libraries, archives, public agencies, and scholarly publishers, the findings highlight the importance of semantic clarity, structural coherence, and transparent knowledge organization in maintaining generative visibility.

Future research should empirically test the operational dimensions proposed here across domains, languages, and platforms; examine how users assess credibility and uncertainty when engaging with synthesised responses; and investigate governance and policy implications of generative visibility. Building on recent systematic reviews of generative AI ethics, applications, and organizational impacts (Afreen et al., 2025; Batista et al., 2024; Lenart, 2025), further work can examine how the mechanisms identified in this study operate across diverse institutional contexts. As generative AI continues to evolve, understanding its epistemic consequences remains a central challenge for information science.

By articulating generative engine optimisation as a theoretically grounded lens for analysing generative visibility and authority, this study provides a foundation for such inquiry.

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Appendix

Appendix A. Data sources consulted

To support the conceptual–analytic literature review, literature was consulted from the following sources:

- Scopus
- Web of Science
- Google Scholar
- Information Research journal archive

These sources were selected to ensure disciplinary coverage across information science, information retrieval, and generative AI research.

Appendix B. Included preprints

Given the rapid development of generative AI research, selected preprints were included where peer-reviewed equivalents were not yet available. These works were used analytically rather than evidentially and are explicitly identified below.

Chen, M., Wang, X., Chen, K., & Koudas, N. (2025). Generative engine optimization: How to dominate AI search. [Preprint] arXiv. https://doi.org/10.48550/arXiv.2509.08919

Liu, Y., Zhang, H., Li, J., Wang, S., & Zhao, T. (2025). CC-GSEO-Bench: A content-centric benchmark for measuring source influence in generative search engines. [Preprint] arXiv. https://doi.org/10.48550/arXiv.2509.05607

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Appendix C. Publications included in the conceptual synthesis

The conceptual synthesis presented in this study draws on a corpus of approximately 65–70 publications spanning information science, algorithmic mediation, and generative search evaluation. Because the study adopts a conceptual–analytic review approach rather than a systematic or bibliometric design, the reference list serves as the authoritative and complete record of the literature informing the analysis, rather than as a delimited review dataset reproduced in the