What is academic innovation: a concept analysis*

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Abstract

Quantitative metrics for assessing innovativeness are increasingly diverse and continually refined; however, a consensus on the definition of academic innovation has yet to be reached. To bridge the gap between incomplete conceptualization and effective operationalization, a reproducible approach for concept analysis is utilized to identify the antecedent, attributes, and consequences of academic innovation, thereby facilitating a comprehensive understanding. The results indicate that academic innovation originates from a new combination of explicit/tacit knowledge, is characterized by novelty, value, contextuality and cumulativeness, and leads to the creation and diffusion of knowledge, as well as the enhancement or transformation of existing paradigms. Our definition of academic innovation is further differentiated from commonly-confused terms to clarify its boundaries, providing a theoretical foundation for reliable measurement.

Keywords

academic innovation, concept analysis, novelty, breakthrough, disruption1

1. Introduction

Innovation is fundamental to the progress and dynamism of academic research. Evaluating the innovation of academic papers in a comprehensive, objective, and reasonable manner is crucial from both management and policy perspectives [1]. It enables effective decision-making for funding allocation as well as resource prioritization, and facilitates the precise recognition of innovative and impactful research, ultimately fostering the advancement of knowledge and maintaining the quality of scholarly work. As a growing field of research interest, quantifying the degree of academic innovation on the basis of bibliometrics or text mining has gained momentum. Some studies assess the innovation of the focal paper within a citation network using an "absorption-output" lens through complex network approaches [2]-[3], while others utilize co-word analysis or semantic similarity calculation to differentiate between new and prior knowledge [4]-[5].

However, to the best of our knowledge, there is no consensus about what academic innovation actually means, resulting in a lack of proper conceptualization to guide accurate and complete operationalization. Moreover, *innovation* and its related terms, such as *novelty* and *breakthrough*, are sometimes employed interchangeably in a single paper, which potentially causes ambiguity in the argumentation or impedes the valid dissemination and application of indicators. Targeting the above problems, we adhere to the standards of Concept Analysis (CA) for conceptual clarification of academic innovation in a rigorous and reproducible way. The objective of this study can be further broken down into two aspects:

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- To conceptualize innovation in the academic context.
- To distinguish academic innovation from its related terms.

2. Related work

Previous studies primarily conceptualize innovation from three perspectives: as a process [6]-[7], as an outcome [8]-[9], and through its characteristics [10]-[11]. Defining innovation as a creative process allows the sequence of innovative activities to be organized into typical phases: generating new or improved ideas (the idea generation phase) and applying them to produce tangible outcomes (the implementation phase) [7]. Defining innovation as an outcome highlights the perceived value of a novel idea or practice to the adopter [9]. Another perspective focuses on the inherent characteristics of innovation, including uncertainty, path dependency, cumulativeness, non-appropriability, irreversibility and tacitness [11]. These single-perspective definitions provide a clear and straightforward view but may give rise to selective emphasis or deviations in operationalization.

In terms of methodology, current definitions of innovation are principally derived through inductive reasoning based on empirical cases or by reconstructing existing concepts. Through an inductive analysis of extensive co-citation patterns, Uzzi [12] argued that high-impact innovation was grounded in balancing atypical combination with conventional knowledge. In contrast, concept reconstruction entails gathering, reconciling, and reorganizing prior definitions into a cohesive one. For instance, Quintane et al. [8] synthesized definitions from multiple fields and considered innovation as duplicable knowledge that is demonstrated to be new and useful in practice. Other studies concretized the notion of innovation by classifying it into dichotomous categories, such as architectural versus modular innovation [13] or disruptive versus developing innovation [14]. Case-based induction may lack comprehensiveness due to contextual constraints, while literature-based reconstruction is limited by the absence of a normative procedure. To tackle the aforementioned issues, we employ concept analysis to provide a holistic understanding of academic innovation in a systematic and standardized manner.

3. Methodology

This study employs Rodgers' concept analysis [15], a methodological framework originally developed in nursing scholarship and increasingly applied within Library and Information Science (LIS) research in recent years [16]-[17][18][19]. This inductive approach facilitates the exploration and development of concepts in a given context, offering deeper insights rather than seeking definitive conclusions. Following the systematic framework of CA, we first select an appropriate "realm" for collecting literature related to innovation. After assembling and screening the search results, we examine each application of academic innovation at a detailed "line-by-line" level to extract key phrases and group semantically-similar ones into separate themes. Subsequently, these themes are categorized as either antecedents, attributes, or consequences of academic innovation.

To guarantee a comprehensive analysis, two rounds of literature retrieval are conducted. Firstly, we confine our search scope to core journals and conference proceedings in the LIS field. The topic "academic innovation" is used to retrieve records and references of the included articles are backward-tracked. Given that economic research paid earlier attention to building innovation theory and establishing its foundational concepts [20], a second round of literature retrieval is performed in the Web of Science and Scopus databases without restrictions on research areas, during which search terms are iteratively refined and supplemented to avoid omitting potential articles.

A total of 4,797 records are identified through the literature search, with 3876 retained after removing duplicates. Articles are included in our analysis if they meet the following criteria: 1) published in a peer-reviewed journal or conference; 2) written in English; 3) discuss the concept of "innovation" or "academic innovation". The process of data collection and concept analysis is

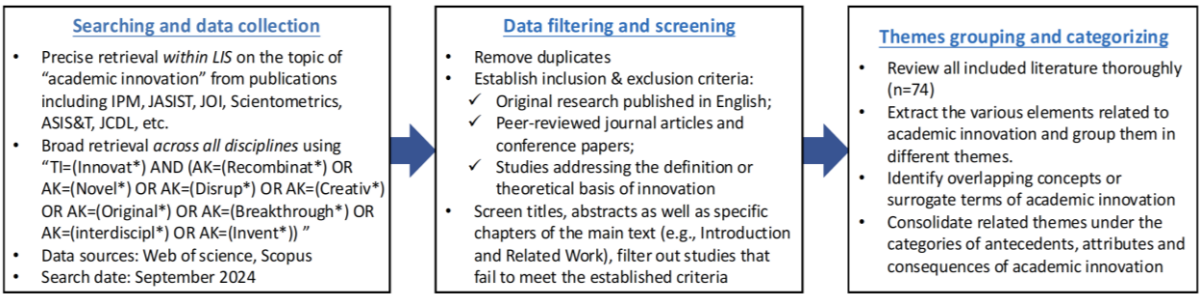

Figure 1: The overall framework of paper-selection and concept analysis.

illustrated in **Figure 1**.

4. Results and analysis

4.1. Antecedent of academic innovation

As emphasized by Kuhn [21], advances in science entail challenging, revising, expanding, or recombining elements of current knowledge. These knowledge elements essentially refer to explicit knowledge that can be clearly represented, systematically codified and easily disseminated [22], which mainly involve concepts, theories, questions, methods, facts, models, and findings. However, knowledge itself can exist in both explicit and tacit forms. Tacit knowledge is deeply embedded in individuals and difficult to formalize or articulate [23], such as intuition or experiences. If we consider knowledge in its broader sense, the antecedent of academic innovation can be extended to ***a new combination of knowledge***, which aligns with the concept of "recombinant search as the source of novelty," as advocated by Schumpeter [24] and Fleming [25].

The new combinations of knowledge can be divided into homogeneous and heterogeneous types, corresponding to the Cha-Cha-Cha theory [26]. Specifically, new combinations within explicit knowledge are associated with the "Charge" category, where the focus is on solving clear problems using known knowledge in new ways. New combinations between explicit and tacit knowledge fit into the "Challenge" category, involving deliberate integration to resolve inconsistencies or explain anomalies. Combinations within tacit knowledge (that finally transform into original explicit knowledge) fall under the "Chance" category, as they often result from serendipitous discoveries made by scientists with a "prepared mind." Analogous to technological innovation, academic innovation can be viewed as a problem-solving process in some cases [27]. Following this perspective, Luo et al. [28] calculated the semantic similarity of question-method combinations to measure the innovation of publications.

4.2. Attributes of academic innovation

Novelty and Value: Novelty is a fundamental and essential feature of any innovation [10], [29]. Since the antecedent of academic innovation lies in the new combination of (explicit/tacit) knowledge, it should reflect newness or uniqueness compared to what already exists. This novelty can manifest in various dimensions, such as introducing original concepts, refining current solutions [27], or creating exceptional connections between previously unrelated ideas [12]. Additionally, commercial innovation emphasizes the practical application of new ideas in products [30], which is similarly applicable to an academic context. Academic innovation is not only a

creative process but also requires application ("exploitation") capable of providing benefits ("value-added") [31], including but not limited to scholarly and societal impact. Depending on the degree of novelty and value, innovation can be categorized into incremental versus radical innovation [32]-[33]. Incremental innovations make slight changes within an established paradigm to support gradual, cumulative progress. By contrast, radical innovations are often considered ruptures along particular knowledge trajectories, leading to reorientations of established research streams onto new frontiers and even the fundamental alteration of prevailing paradigms.

Contextuality and Cumulativeness: Apart from novelty and value, academic innovation inherently exhibits both contextual dependency and cumulative progression. The absorption and dissemination of scientific knowledge vary with specific temporal and spatial contexts, domain characteristics, and societal needs [34]. This difference means that academic innovation does not occur in isolation but engages in complex interactions with various surrounding factors [35], ultimately causing it to take diverse forms across periods and fields. For example, innovation research has evolved from being driven by economic traditions to a stage where management theories gain prominence and ultimately take the lead [36]. Besides, the innovation process is argued to be continuously cumulative in both temporal and spatial dimensions [6], [37]. The temporal cumulativeness of academic innovation is generally tied to the cumulative property of individual learning [37], because prior knowledge permits the assimilation, utilization, creation, and transformation of new knowledge [38]. Spatially, the cumulativeness of innovation is both an outcome and a driver of a well-functioning innovation system, where regional policies, collaborative networks, and infrastructures play a crucial role in sustaining and building upon existing innovation.

4.3. Consequences of academic innovation

From the perspective of its impact on established paradigms, academic innovation either leads to ***enhancement or a complete transformation*** [21], [39]. The transition from the overthrow of an old paradigm to the emergence of a new one can be further divided into two pathways. The first involves disrupting the existing paradigm and reshaping it into a new paradigm [40]-[41][42]. For example, the shift from classical mechanics to quantum mechanics entailed breaking down the previous framework of understanding, incorporating quantum concepts while retaining certain elements of classical physics where applicable. The second involves creating a completely new paradigm that is incompatible with the existing one and eventually replaces it [43]. For instance, the development of the heliocentric model by Copernicus supplanted the geocentric model, introducing a radically new way of understanding planetary motion that was entirely distinct from the earlier view.

A considerable amount of research on innovation-driven economy has empirically confirmed the knowledge spillover effect of universities' innovative outcomes on local firms' innovation [44]-[45]. From the perspective of academic research, these findings imply that the consequence of innovation can be ***the creation of new explicit knowledge, the diffusion and dissemination of existing knowledge, or a combination of both***. Such knowledge creation and diffusion is triggered by decisions on which (explicit/tacit) knowledge to recombine (i.e., the antecedent of academic innovation) [27]. Note that flows of knowledge can take place within or across organizational, disciplinary, or national boundaries, and eventually form a scientific innovation network. Drawing on this viewpoint, several studies construct collaboration or citation networks to explore the inter-community knowledge diffusion and subsequently evaluate academic innovation [46]-[47][48].

4.4. Definition of academic innovation

Based on the discussions above, our concept analysis of academic innovation yields the following definition: academic innovation originates from a new combination of (explicit/tacit) knowledge,

which initiates flows of knowledge and leads to the creation and diffusion of knowledge. Simultaneously, it contributes to either the enhancement of existing paradigms or the emergence of a new one. This creative process exhibits a cumulative nature but varies with specific context, emphasizing both novelty and value, regardless of how they may manifest.

4.5. Differentiating innovation and related terms

As seen in **Figure 2**, our proposed definition provides multiple dimensions for understanding academic innovation (covering the antecedent, attributes, and consequences), making it possible to compare innovation with its overlapping concepts in groups.

Originality, novelty versus Innovation: A new combination of knowledge serves as the prerequisite for all three concepts, whereas originality and novelty tend to prioritize the "new" aspect without imposing a strict requirement for value [49]-[50]. Originality is defined as the extent to which a scientific discovery contributes unique knowledge that is absent in prior studies [51]. It embodies the advancement of taking the first step into an unexplored area (from zero to one) [52], with tacit knowledge as a core component in the combination process. From a results-oriented standpoint, original outcomes are unexpected and surprising [53], which can spark pioneering ideas to stimulate further innovation. By comparison, novelty may also arise through an unusual combination of pre-existing explicit knowledge [25] without necessarily delving into unknown territories or obtaining surprising findings.

Disruption, breakthrough versus innovation: Innovation is the broadest concept among them, the consequences of which encompass incremental improvements and radical transformations [54]. Disruption and breakthrough are two distinct types of innovation, both bringing about changes to scientific paradigms [55]-[56][57]. In contrast to incremental innovation, disruption refers to innovative research that destabilizes established knowledge [58] and renders previous knowledge obsolete [59]. Breakthroughs, on the other hand, are high-value, high-quality innovations that overcome significant obstacles and provide foundational knowledge for future developments [60], whose impact can even be observed in a short time [61]. It is worth noting that breakthroughs are not exclusively associated with radical paradigm shifts; they may originate from prior incremental innovations and can be competence-enhancing as well [62].

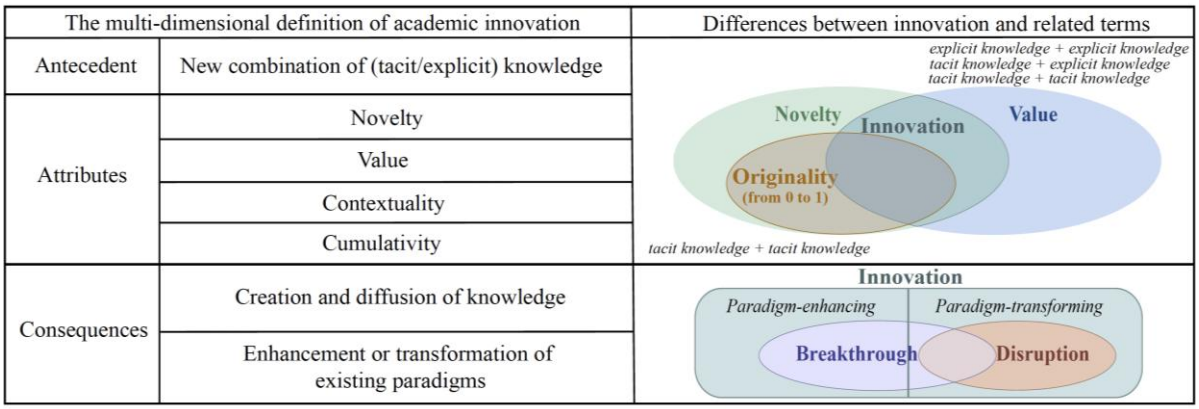

Figure 2: Clarifying academic innovation and its overlapping concepts through various aspects pertaining to the antecedent, attributes, and consequences. The *italicized labels* highlight the distinguishing factors among terms.

5. Conclusion and future work

This paper adopts concept analysis to define academic innovation in a heuristic and inductive manner. Innovation-related studies in the LIS realm are compared and synthesized, supplemented

by literature from other fields on broader concepts of close association. On this basis, we elaborate the connotation of academic innovation from three perspectives: antecedents (i.e., a new combination of explicit/tacit knowledge), attributes (i.e., novelty and value, contextuality and cumulativeness), as well as consequences (i.e., the creation and diffusion of knowledge, and the enhancement or transformation of existing paradigms). Moreover, our definition of academic innovation is further distinguished from commonly-confused terms to clarify its boundaries, providing a valuable reference for the construction and refinement of quantitative indicators.

Our preliminary exploration seeks to understand the meaning of innovation in an academic context with a reproducible method. In fact, conceptualization and operationalization create a dynamic relationship where each step continuously shapes the other to ensure both theoretical clarity and practical measurability. In the future, we will systematically review existing metrics for measuring innovation and its sub-dimensions, so as to expound on the linkages between the definitions that are used and the indicators that are created.

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Declaration on Generative AI

The authors have not employed any Generative AI tools.

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