Annals of Library and Information Studies
Vol. 72, June 2025, pp. 201-209
DOI: 10.56042/alis.v72i2.16355

Revisiting the APUPA Pattern: Analysing the Publication Fall Index in DNA Fingerprints Research

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Received: 12 January 2025; Accepted: 21 April 2025

This research revisits the APUPA pattern, focusing on the DNA Fingerprints domain, and introduces the "Publication Fall Index" (PFI) as a quantitative indicator to identify subjects on the boundary between core and allied domains. Analysing publications from 1985 to 2014, core subjects such as Biochemistry, Genetics, and Molecular Biology, and Medicine consistently emerge. The study utilises Ranganathan's concepts and methodologies, including the APUPA arrangement, to define the hierarchical relationship between subjects. Through analytical formalism, the research introduces the concept of Relative Facet Strength (RFS) and its modification into PFI to address the impact of different article numbers. Findings reveal shifts in core subjects and the emergence of allied subjects over time. Notably, Agricultural and Biological Sciences, Immunology, Microbiology, and Environmental Science demonstrate significant PFI values, indicating their roles as core subjects. The study contributes to understanding knowledge organisation within DNA Fingerprints research, highlighting the dynamic relationship between core and allied subjects. This research underscores the utility of the APUPA pattern and PFI in delineating subject boundaries, aiding researchers in identifying core areas of study within interdisciplinary fields like DNA Fingerprints.

Keywords: APUPA Pattern, Publication Fall Index, Relative Facet Strength, DNA Fingerprints

Introduction

In the complex realm of knowledge organisation, the APUPA pattern serves as a guiding principle, navigating researchers through the intricate interplay between core and allied subjects. This study explores the domain of DNA Fingerprints, illuminating the resurgence of the APUPA pattern while introducing the innovative "Publication Fall Index" (PFI) as a quantitative tool for subject delineation. The boundaries between core and allied domains are crucial in the interdisciplinary landscape, shaping our understanding of knowledge organisation. This research delves into the dynamic field of DNA Fingerprints, reassessing the APUPA pattern through the lens of the newly proposed PFI. Originating from the pioneering work of S.R. Ranganathan, the APUPA pattern offers a systematic framework for classifying knowledge, emphasising hierarchical relationships among subjects. By building upon Ranganathan's foundational concepts, this study introduces PFI as a quantitative indicator, shedding light on the evolving landscape of core and allied subjects within DNA Fingerprints. This approach aims to provide valuable insights into the dynamic nature of interdisciplinary research and contribute to advancing knowledge organisation in this field.

Literature Review

The APUPA pattern, a cornerstone of S.R. Ranganathan's[1-2] contributions to library classification, has been explored extensively for its theoretical foundations and practical applications in library and information science. Ranganathan's pioneering work in the mid-20th century, particularly his development of the Colon Classification system and its components—phase, facet, round, level, and zone—set a new precedent in organising knowledge across expanding domains. His 1955 analysis highlighted the importance of addressing psychological and physiological limits in classification[3], ensuring usability and scalability in documentation and book organisation.

In 1958, Ranganathan[4] emphasised the integral role of library services in societal domains such as economics, research, democracy, and education. He proposed a cohesive national library framework, focusing on principles for effective document retrieval. This foundational work underscored the enduring relevance of his classification theories. Parthasarathy[5] further analysed the innovative features of the Colon Classification, emphasising its dynamic nature and influence on subsequent classification schemes globally. The adaptability of Ranganathan's analytico-synthetic methodology, deeply rooted in the Five Laws of Library Science, has been a recurrent theme in scholarly discourse. Neelameghan[6] highlighted its enduring relevance, connecting Ranganathan's methods to modern technologies such as faceted search and object-oriented databases. Ranganathan's notion of Abstract Classification, akin to pure mathematics, reinforced the necessity of deep classification to optimise documentation work, a concept further examined by Satija[7] who elucidated the multidimensional nature of knowledge within the Colon Classification. Ranganathan's contributions transcended theoretical constructs, adapting seamlessly to practical challenges in library science. Neelameghan[8] discussed how digital technologies necessitated new dimensions in information organisation, showcasing the Colon Classification's adaptability to digital systems. Mohan[9] compared Ranganathan's principles to the Entity-Relationship model in data modeling, underscoring their timeless relevance in contemporary knowledge management.

While Ranganathan's theories have been widely celebrated, critiques have also emerged, encouraging refinement. Subbarao[10] raised questions about the practical implementation of the APUPA pattern and open access systems, stimulating further exploration of their impact on user experience. Bianchini, Giusti, and Gnoli[11] analysed the APUPA model within broader contexts, comparing it with other classification theories to highlight its originality and complexity. Their work revealed how the APUPA pattern effectively addresses the logical structure of knowledge, making it a unique framework in classification research.

Satija and Singh[12] offered a comprehensive historical overview of the Colon Classification, tracing its evolution through seven editions from 1928 to 1987. Their analysis highlighted the system's capacity to incorporate emerging ideas, ensuring its relevance. Giusti[13] delved into the cultural underpinnings of the APUPA pattern, demonstrating its adaptation to modern digital challenges. Panigrahi[14] explored the intersection of Artificial Intelligence (AI) with library classification, extending Ranganathan's principles to automatic classification systems. This innovative approach demonstrated how AI could enhance analytico-synthetic methods, making Ranganathan's ideas pivotal in online information retrieval and data mining. Recent studies have emphasised the broader implications of Ranganathan's theories. Giri[15] investigated factors influencing citation patterns in library science, including the phenomenon of cumulative advantage, a theme expanded by Dutta[16,] who proposed new metrics for analysing citation distributions. These studies indirectly validated the relevance of Ranganathan's frameworks in contemporary bibliometric analyses.

Ranganathan's influence extends beyond India, as demonstrated by Bianchini[17,] who chronicled the adoption of his theories in Italy. The translation and integration of his works into new cultural contexts highlight the universal applicability of his ideas. This global diffusion underscores the enduring impact of the APUPA pattern and its relevance in diverse library systems.

Shakunthala[18] discussed the APUPA pattern's role in resource management and collection development, emphasising its contribution to enhancing library accessibility. Samantaray[19] echoed this sentiment, stressing the need for librarians to understand the pattern for efficient library administration. Dutta[20] explored the evolving landscape of information searching in the digital age.

Glassel[21] presented a nuanced perspective on Ranganathan's legacy and explored his theories' relevance in contemporary library practice. Modern reflections on Ranganathan's work reveal its profound impact on knowledge organisation. Weingart[22] examined the evolution from hierarchical knowledge trees to networked classifications, situating Ranganathan's theories within this epistemic shift. Satija's[23-24] review of Introduction to Knowledge Organization discussed the rapid evolution of knowledge organisation systems (KOSs) in the digital era, critiquing the relevance of Ranganathan's hierarchical approach for non-textual data. Kumar and Singh[25] discuss current classification systems, primarily based on UNESCO's hierarchy, are insufficient. The study proposes a more comprehensive system for effective ICH management and interoperability.

Ranganathan's[26] works, including Documentation and Its Facets, continue to serve as seminal references, compiling foundational insights into library science and documentation. This compilation, along with other critiques and expansions, highlights the iterative growth of library science as a discipline.

Ranganathan's APUPA pattern remains integral as library science evolves, offering theoretical insights and practical frameworks. The extensive body of research on his contributions underscores their adaptability and relevance in the digital age. From analogue systems to modern AI-driven methodologies, Ranganathan's principles continue to shape knowledge organisation, reflecting their foundational and transformative nature in a rapidly changing information landscape.

Objectives

With a steadfast commitment to advancing knowledge boundaries, this research endeavours to:

- To introduce the Publication Fall Index (PFI) as a quantitative indicator in subject identification.
- To highlight core and allied subjects within the domain of DNA Fingerprints.
- To analyse the shifting landscape of core and allied subjects over three decades.
- To explore the APUPA pattern's efficacy in delineating subject boundaries.

Methodology

Shiyali Ramamrita Ranganathan, the father of Library Science, developed the APUPA concept to define the natural and hierarchical relationship of materials in a bibliographic classification scheme. Documents were classified into three types: Umbral, Penumbral, and Alien. The APUPA arrangement followed the pattern: Alien-Penumbral-Umbral-Penumbral-Alien, and the researcher formulated the "Publication Fall Index" (PFI) to define the borderline of the core and allied subject area.

Analytical Formalism of the concepts of diffusion of a facet over different subjects

Suppose, in any facet ('F', say) over a stipulated period, 'N' number of articles is published. Of these 'N' articles, say,

'N_1' number of articles attributed to the Facet F_1 and ranked one (1), i.e. highest rank

'N_2' number of articles attributed to the Facet $F_2$and Ranked two (2)

'N_3' number of articles attributed to the Facet F_3 and Ranked three (3) and so on.

Similarly

'$N_{(N-2)}$' number of articles attributed to the Facet $F_{(N-2)}$ and Ranked (N-2)

'$N_{(N-1)}$' number of articles attributed to the Facet $F_{(N-1)}$ and Ranked (N-1)

'N_N' number of articles attributed to the Facet F_N and Ranked (N), i.e. lowest rank

Where, $N = N_1 + N_2 + N_3 + ... + N_{(N-2)} + N_{(N-1)} + N_N = \sum_{i=1}^{N} N_i$ = Total number of articles,

$N_1 > N_2 > N_3 > .... > N_{(N-2)} > N_{(N-1)} > N_N$ and

Let us now introduce an indicator "Relative Facet Strength" (RFS) as follows:

$$RFS = \frac{N_i - N_{(i+1)}}{N_i}; N_i > N_{(i+1)} \quad ... (1)$$

where, N_i stands for the number of articles that belonged to the facet F_i and $N_{(i+1)}$ stands for the number of articles that belonged to the facet F_{i+1}. Usually, multiple numbers of articles exist in any ranked facet, particularly for relatively higher-ranked facets. The number of articles for lower-ranked facets gradually diminishes, eventually reducing to 1. Degenerate ranking is not observed for higher-ranked facets but is very common for lower-ranked facets. Therefore, many facets are found with only one article each, followed by slightly fewer facets with two articles each, even fewer with three articles each, and so on. Equation (1) indicates the RFS for any two successively ranked facets. The total RFS for 'N' facets can be given as:

$$\sum RFS = \sum \frac{N_i - N_{(i+1)}}{N_i};\ N_i > N_{(i+1)} \quad ... (2)$$

For instance, the RFS values are the same when transitioning from 3 to 2 articles, 30 to 20, or 300 to 200 (i.e., 1/3). However, statistically, these cases differ due to varying weightage. The impact difference between facets of 300 and 200 articles is greater than between facets of 30 and 20. To address this, Equation (1) of RFS is amended by multiplying with another factor, viz. $\sqrt{(N_i + N_{i+1})}$, resulting in the new indicator, the name given to which is "Publication Fall Index" (PFI). PFI yields higher values for facets with more articles and lower for those with fewer, indicating the fall in article numbers between successive facets.

$$\therefore PFI = RFS \times \sqrt{(N_i + N_{(i+1)})} = \frac{(N_i - N_{(i+1)})}{N_i} \times \sqrt{(N_i + N_{(i+1)})} \quad ... (3)$$

Equation (3) represents the formula for the "Publication Fall Index" (PFI).

In the domain of DNA Fingerprints, the count of core or umbral subjects surpasses that of allied or penumbral subjects. The subject with the highest PFI within a domain delineates the boundary between the umbral and penumbral zones in the APUPA pattern. This highest PFI denotes the shift from the umbral to the penumbral zone, serving as a decisive indicator for demarcating between these two areas.

Scope and Limitation

This study collected bibliographic data related to DNA Fingerprints from the Scopus database as of February 12, 2023. The literature was retrieved using the keyword “DNA Fingerprints” within the TITLE-ABS-KEY field, covering the period from 1985 to 2022. Scopus is widely recognized for its comprehensive coverage of scientific and technological research. For the purpose of analysis, only records from the subject area and the top ten subject categories were considered. The data was divided into three distinct time periods: 1985–1994, 1995–2004, and 2005–2014, each representing a complete decade. The final period, 2015–2022, spans only eight years and does not represent a full decade. However, the data and analysis from the three complete decades sufficiently reflect the objectives of the study. Consequently, the subject-wise analysis was primarily based on these three timeframes. While the current findings provide meaningful insights, the inclusion of additional databases and a complete ten-year span for the most recent period would further strengthen the study's robustness and comprehensiveness.

Data Analysis

Table 1, Table 2 and Table 3 present the top ten subjects in DNA Fingerprints publications, with each subject's 10-year cumulative value (CV) calculated for 1985-94, 1995-04, and 2005-14. Cumulative value (CV) was organised in descending order, and then each subject's Publication Fall Index"(PFI)

$$[PFI = RFS \times \sqrt{(N_i + N_{(i+1)})} = \frac{(N_i - N_{(i+1)})}{N_i} \times \sqrt{(N_i + N_{(i+1)})}]$$

was calculated with the help of this formula derived in the methodology part. Table 4, Table 5, and Table 6

Table 1 — Number of Articles and Cumulative Value Published in Various Subject Areas on DNA Fingerprints from 1985 to 1994

SL No.	Subject	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1985-94 CV
1	Biochemistry, Genetics and Molecular Biology	0	3	9	17	22	33	43	62	33	34	256
2	Medicine	1	4	10	17	26	35	36	41	42	11	223
3	Agricultural and Biological Sciences	0	0	1	1	8	11	26	34	13	31	125
4	Undefined	0	0	0	0	0	0	0	1	50	0	51
5	Immunology and Microbiology	1	1	0	1	2	3	12	16	6	7	49
6	Multidisciplinary	4	5	4	1	2	3	2	6	2	4	33
7	Veterinary	1	0	2	0	1	1	5	3	4	5	22
8	Environmental Science	0	0	0	0	2	1	4	7	2	5	21
9	Chemistry	0	0	1	1	0	0	6	1	2	1	12
10	Social Sciences	0	0	1	0	2	0	1	2	2	4	12

Table 2 — Number of Articles and Cumulative Value Published in Various Subject Areas on DNA Fingerprints from 1995 to 2004

SL No.	Subject	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1995-04 CV
1	Agricultural and Biological Sciences	47	48	51	60	32	37	42	49	45	37	448
2	Medicine	44	32	43	51	36	45	36	41	34	34	396
3	Biochemistry, Genetics and Molecular Biology	53	48	30	40	36	31	21	37	41	23	360
4	Immunology and Microbiology	23	19	16	22	16	15	13	14	18	12	168
5	Environmental Science	6	6	6	10	3	10	8	5	8	13	75
6	Veterinary	4	5	4	6	7	5	5	4	3	3	46
7	Chemistry	4	0	4	3	1	1	2	2	7	3	27
8	Pharmacology, Toxicology and Pharmaceutics	2	1	1	2	4	5	4	2	3	3	27
9	Engineering	2	0	0	3	1	0	0	5	3	4	18
10	Multidisciplinary	4	1	2	0	1	1	1	2	1	1	14

Table 3 — Number of Articles and Cumulative Value Published in Various Subject Areas on DNA Fingerprints from 2005 to 2014

SL No.	Subject	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2005-14 CV
1	Agricultural and Biological Sciences	38	40	47	28	37	26	33	22	18	31	320
2	Biochemistry, Genetics and Molecular Biology	24	28	28	13	25	18	27	16	22	28	229
3	Medicine	28	23	27	19	19	20	23	16	10	17	202
4	Immunology and Microbiology	15	18	16	10	14	13	12	12	11	17	138
5	Environmental Science	7	7	14	7	10	8	11	6	11	4	85
6	Engineering	1	4	1	1	1	6	8	5	3	1	31
7	Multidisciplinary	3	0	1	2	8	0	4	5	3	5	31
8	Veterinary	1	7	3	3	4	3	0	2	4	2	29
9	Pharmacology, Toxicology and Pharmaceutics	3	3	1	2	1	2	7	4	1	4	28
10	Computer Science	2	3	2	3	1	3	1	5	1	3	24

Table 4 — Cumulative value & PFI values during 1985-94 in DNA Fingerprints

SL No.	Subject	1985-94 CV	1985-94 PFI
1	Biochemistry, Genetics and Molecular Biology	256	---
2	Medicine	223	2.82
3	Agricultural and Biological Sciences	125	8.20
4	Undefined	51	7.85
5	Immunology and Microbiology	49	0.39
6	Multidisciplinary	33	2.96
7	Veterinary	22	2.47
8	Environmental Science	21	0.30
9	Chemistry	12	2.46
10	Social Sciences	12	0.00

Table 5 — Cumulative value & PFI values during 1995-04 in DNA Fingerprints

SL No.	Subject	1995-04 CV	1995-04 PFI
1	Agricultural and Biological Sciences	448	
2	Medicine	396	3.37
3	Biochemistry, Genetics and Molecular Biology	360	2.5
4	Immunology and Microbiology	168	12.26
5	Environmental Science	75	8.63
6	Veterinary	46	4.25
7	Chemistry	27	3.53
8	Pharmacology, Toxicology and Pharmaceutics	27	0
9	Engineering	18	2.24
10	Multidisciplinary	14	1.26

Table 6 — Cumulative value & PFI values during 2005-14 in DNA Fingerprints

SL No.	Subject	2005-14 CV	2005-14 PFI
1	Agricultural and Biological Sciences	320	
2	Biochemistry, Genetics and Molecular Biology	229	6.66
3	Medicine	202	2.45
4	Immunology and Microbiology	138	5.84
5	Environmental Science	85	5.74
6	Engineering	31	6.84
7	Multidisciplinary	31	0.00
8	Veterinary	29	0.50
9	Pharmacology, Toxicology and Pharmaceutics	28	0.26
10	Computer Science	24	1.03

display the calculation of the Publication Fall Index (PFI) during 1985-94, 1995-04, and 2005–14 in DNA Fingerprints accordingly.

Table 1 presents here the number of articles and cumulative value published in various subject areas on DNA fingerprints from 1985 to 1994. From 1985 to 1994, DNA fingerprints significant research activity across various subject areas. Biochemistry, Genetics, and Molecular Biology led with 256 articles, peaking in 1991. Medicine followed with 223 articles, peaking in 1993. Agricultural and Biological Sciences published 125 articles, with the most in 1994. Undefined subject areas contributed 51 articles, all in 1993. Immunology and Microbiology produced 49 articles, peaking in 1992. Multidisciplinary research had 33 articles, starting strongly in 1985. Veterinary and Environmental Science each had notable peaks in 1994, with 22 and 21 articles, respectively. Chemistry and Social Sciences published 12 articles over the period, with their highest activity in 1991 and 1994, respectively.

Table 2 presents here the number of articles and cumulative values published in various subject areas on DNA fingerprints from 1995 to 2004. From 1995 to 2004, the topic of DNA Fingerprints saw the highest research activity in Agricultural and Biological Sciences with 448 articles, peaking in

1998. Medicine followed with 396 articles, peaking in 1998 as well. Biochemistry, Genetics, and Molecular Biology published 360 articles, with the highest activity in 1995. Immunology and Microbiology produced 168 articles, with a peak in 1995. Environmental Science had 75 articles, peaking in 2004. Veterinary Science contributed 46 articles, with the most in 1999. Both Chemistry and Pharmacology, Toxicology, and Pharmaceutics had 27 articles each, peaking for Chemistry in 2003 and for Pharmacology in 2000. Engineering published 18 articles, peaking in 2002. Multidisciplinary research had 14 articles, with the highest in 1995.

Table 3 also presents here the number of articles and cumulative value published in various subject areas on DNA Fingerprints from 2005 to 2014. From 2005 to 2014, research on DNA Fingerprints was most active in Agricultural and Biological Sciences, with 320 articles, peaking in 2007. Biochemistry, Genetics, and Molecular Biology followed with 229 articles, highest in 2006 and 2007. Medicine produced 202 articles, peaking in 2005. Immunology and Microbiology had 138 articles, with a peak in 2006. Environmental Science published 85 articles, peaking in 2007 and 2013. Engineering and Multidisciplinary research each had 31 articles, with Engineering peaking in 2011 and Multidisciplinary in 2009. Veterinary Science had 29 articles, peaking in 2006. Pharmacology, Toxicology, and Pharmaceutics produced 28 articles, peaking in 2011. Computer Science had 24 articles, with peaks in 2008 and 2012. From 2005 to 2014, research on DNA Fingerprints was most active in Agricultural and Biological Sciences, with 320 articles, peaking in 2007. Biochemistry, Genetics, and Molecular Biology followed with 229 articles, highest in 2006 and 2007. Medicine produced 202 articles, peaking in 2005. Immunology and Microbiology had 138 articles, with a peak in 2006. Environmental Science published 85 articles, peaking in 2007 and 2013. Engineering and Multidisciplinary research each had 31 articles, with Engineering peaking in 2011 and Multidisciplinary in 2009. Veterinary Science had 29 articles, peaking in 2006. Pharmacology, Toxicology, and Pharmaceutics produced 28 articles, peaking in 2011. Computer Science had 24 articles, with peaks in 2008 and 2012.

Table 4 displays the Cumulative value & PFI values during 1985-94 in DNA fingerprints. In 1985-94 the highest PFI value (8.20) for Agricultural and Biological Sciences marked the penumbral region's beginning, with core subjects such as Biochemistry, Genetics and Molecular Biology, Medicine, and allied subjects, including Agricultural and Biological Sciences, Multidisciplinary, Undefined, Immunology and Microbiology, Veterinary, Environmental Science, Chemistry and Social Sciences.

Table 5 presents the Cumulative value & PFI values during 1995-04 in DNA Fingerprints 1995-04, Immunology and Microbiology's highest PFI value was 12.26, with Agricultural and Biological Sciences included as a core subject, maintaining core and allied subjects from the previous periods (1985-94), except Engineering, Pharmacology, Toxicology and Pharmaceutics replaced Undefined and Social Sciences.

Table 6 shows the Cumulative value & PFI values during 2005-14 in DNA fingerprints. 2005-14, Engineering had the highest PFI values of **6.84**, with Immunology and Microbiology and Environmental Science included as core subjects. Other allied subjects remained consistent with the preceding decade (195-04), except Computer Science replaced Chemistry.

Table 7 reveals the highest Publication Fall Index (PFI) values for the respective 10-year cumulative periods. In the years 1985-94, Agricultural and Biological Sciences had a PFI of 8.20, while in 1995-04, Immunology and Microbiology recorded a PFI of 12.26. Finally, in the period 2005-14, Engineering attained a PFI of 6.84.

From Table 8, the core subjects identified across the three periods are as follows: During 1985-94, Biochemistry, Genetics, and Molecular Biology along with Medicine emerged as core subjects. In the period 1995-04: Agricultural and Biological Sciences, Medicine, and Biochemistry, Genetics, and Molecular Biology remained central. By 2005-14: Agricultural and Biological Sciences regained prominence as a core subject, accompanied by Biochemistry, Genetics, and Molecular Biology, with an additional focus on Medicine, Immunology, Microbiology, and Environmental Science.

Table 9 provides the allied subjects over the given periods as follows. In the period 1985-94, the allied

Table 7 — Highest PFI values during 1985-94, 1995-04 and 2005–14 in DNA Fingerprints

Highest value of PFI for the 10-year cumulative Value		
Year	Subject	PFI
1985-94	Agricultural and Biological Sciences	8.20
1995-04	Immunology and Microbiology	12.26
2005-14	Engineering	6.84

Table 8 — Core Subjects during 1985-94, 1995-04 and 2005–14 in DNA Fingerprints

Core Subject		
1985-94	1995-04	2005-14
Biochemistry, Genetics and Molecular Biology	Agricultural and Biological Sciences	Agricultural and Biological Sciences
Medicine	Medicine	Biochemistry, Genetics and Molecular Biology
	Biochemistry, Genetics and Molecular Biology	Medicine
		Immunology and Microbiology
		Environmental Science

Table 9 — Allied Subjects during 1985-94, 1995-04 and 2005–14 in DNA Fingerprints

Allied subjects		
1985-94	1995-04	2005-14
Agricultural and Biological Sciences	Immunology and Microbiology	Engineering
Undefined	Environmental Science	Multidisciplinary
Immunology and Microbiology	Veterinary	Veterinary
Multidisciplinary	Chemistry	Pharmacology, Toxicology and Pharmaceutics
Veterinary	Pharmacology, Toxicology and Pharmaceutics	Computer Science
Environmental Science	Engineering	
Chemistry	Multidisciplinary	
Social Sciences		

subjects included Undefined, Immunology and Microbiology, Multidisciplinary, Veterinary, Environmental Science, Chemistry, and Social Sciences. In the period 1995-04, the allied subjects are Immunology and Microbiology, Environmental Science, Chemistry, Pharmacology, Toxicology and Pharmaceutics, Veterinary, and Engineering. In the period 2005-14, the allied subjects comprise Engineering, Multidisciplinary, Veterinary, Pharmacology, Toxicology and Pharmaceutics, Computer Science, and Environmental Science.

Fig. 1, Fig. 2, and Fig. 3 display the Core and Allied Subjects (Umbral and Penumbral) during 1985-94, 1995-04, and 2005-14 in DNA Fingerprints through the APUPA pattern.

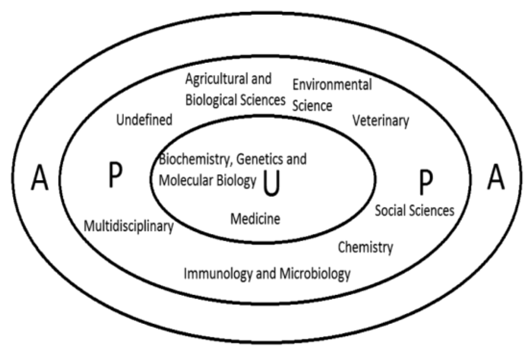

Fig. 1 — Core and Allied Subjects (Umbral and Penumbral) during 1985-94 in DNA Fingerprints

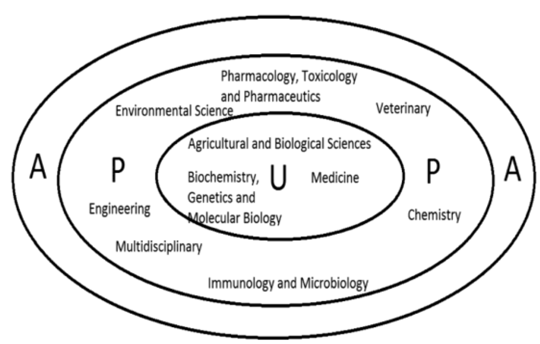

Fig. 2 — Core and Allied Subjects (Umbral and Penumbral) during 1995-04 in DNA Fingerprints

Findings

The analysis of DNA Fingerprints research from 1985 to 2014 reveals evolving trends across various disciplines, with core and allied subjects shifting over time. From 1985-94, core subjects were Biochemistry, Genetics, and Molecular Biology, and Medicine, with Agricultural and Biological Sciences showing the highest Publication Fall Index (PFI). In the period 1995-04, core subjects expanded to include Agricultural and Biological Sciences, with Immunology and Microbiology displaying the highest PFI. By 2005-14, core subjects further diversified, incorporating Environmental Science and Engineering, which had the highest PFI. Throughout these periods, the research activity was most prolific in Agricultural and Biological Sciences, Biochemistry, Genetics and Molecular Biology, and Medicine, reflecting the interdisciplinary nature and expanding scope of DNA fingerprint research.

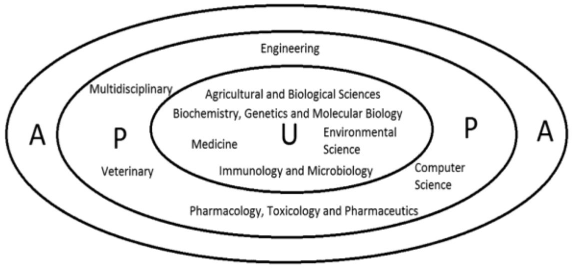

Fig. 3 — Core and Allied Subjects (Umbral and Penumbral) during 2005-14 in DNA Fingerprints

Discussion

The research's findings offer valuable insights into the evolving landscape of DNA fingerprint research, shedding light on the dynamic relationship between core and allied subjects. Over the three decades analysed, certain subjects consistently emerged as core areas, including Biochemistry, Genetics, and Molecular Biology, and Medicine. However, the study also reveals notable shifts in the prominence of allied subjects, such as Agricultural and Biological Sciences, Immunology, Microbiology, and Environmental Science. The introduction of the Publication Fall Index (PFI) as a quantitative tool enriches the understanding of subject delineation within DNA Fingerprints research. By quantifying the relative strength of facets and their diffusion over different subjects, the PFI offers a nuanced perspective on the hierarchical relationship between core and allied subjects. This analytical approach enhances the efficacy of the APUPA pattern in delineating subject boundaries, providing researchers with a robust framework for navigating interdisciplinary fields.

Conclusion

This study revisits the APUPA pattern within the context of DNA Fingerprints research and introduces the "Publication Fall Index" (PFI) as a quantitative tool to identify core and allied subjects. By analysing publications from 1985 to 2014, the research reveals the dynamic nature of core subjects, such as Biochemistry, Genetics, and Molecular Biology, and Medicine, which have consistently emerged over the decades. The introduction of PFI and its application highlights significant shifts and the emergence of allied subjects, including Agricultural and Biological Sciences, Immunology, Microbiology, and Environmental Science.

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