COMPUTATIONAL MAPPING USING VOSVIEWER IN THE ANALYSIS OF BEHAVIORAL FINANCE AND SCIENCE TECHNOLOGY PUBLICATIONS

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Abstract

It addresses research in behavioral science and science innovation using bibliometric strategies and explores computational mapping using VOSviewer. The analyzed article information was obtained from Google Researcher through the Distribute or Die reference administration application. The appearance handle focuses on the phrase "behavioral back and science technology", which has been cited in 801 relevant articles. This study focuses on articles indexed in Google Scholar in the last 10 years, from 2013 to 2022.

This study presents findings that research in the context of behavioral finance and science technology can be grouped into three main concepts, namely behavioral finance, science and technology. In the category "behavioral finance" there are 66 links and 153 total links. Additionally, in the category "Science Technology" there are 46 links out of 64 links. Meanwhile, in the category "Science" there are 212 links out of 2816 links. In the next technology category there are 208 links with 2590 links.

Over the past 10 years, the results of the development of behavioral finance and scientific technology research publications show significant fluctuations. In 2013-2014, there was a decrease in the number of publications, then in 2014-2015, it increased from 114 in 2014 to 127 in 2015. Furthermore, a sharp decline was observed in the study between 2016 and 2022. The number of publications per year was respectively 112, 105, 80, 60, 48, 20 and 8. So, the highest research was in 2013 and 2015, namely 127 researches in the field of behavioral finance and scientific technology.

We also conducted an analysis using VOSviewer to investigate how many articles were published with relevant topics on behavioral finance and science technology. The results of this review can provide valuable initial insight into related research on this topic, as well as open opportunities for further research in this area.

Keywords: bibliometric, computational mapping analysis, behavioral finance, science, technology, scientific technology, VOSviewer

1. Introduction

Behavioral finance research continues to expand, demonstrating that behavioral finance is an important area of financial research. The field of behavioral finance focuses more on the study of judgment errors and characteristics when making investment decisions. Therefore, behavioral finance is important research[1].

Behavioral finance is an area of finance that explains stock market anomalies by exploiting and identifying psychological biases and ignoring the market efficiency hypothesis.[2]Behavioral finance is a growing field of research that replaces and complements traditional and modern

finance with new research based on irrational investors. However, further research is needed to clarify recent developments in the field of financial management, particularly behavioral finance research.Behavioral finance is a field of study within finance that combines elements of psychology with traditional financial theory to understand and explain how individuals and markets make financial decisions. It recognizes that people often do not make rational decisions when it comes to their finances, and it seeks to explore the various psychological biases and emotional factors that influence financial choices.

Key concepts and principles of behavioral finance include behavioral finance identifies a range of cognitive biases and heuristics (mental shortcuts) that can lead individuals to make irrational financial decisions. These biases include overconfidence, loss aversion, confirmation bias, and herding behavior.Proposed by Daniel Kahneman and Amos Tversky, prospect theory suggests that individuals make decisions based on perceived gains and losses relative to a reference point, rather than in absolute terms. This leads to risk-seeking behavior in the domain of losses and risk-averse behavior in the domain of gains.Behavioral finance examines how biases impact investment decisions, portfolio management, and asset pricing. For instance, investors may be reluctant to sell losing investments (loss aversion) or may have unrealistic expectations about future returns.Behavioral finance challenges the efficient market hypothesis, which posits that all available information is instantly reflected in asset prices. Behavioral economists argue that market inefficiencies exist due to the influence of psychological factors.

Behavioral finance has practical applications in investment management, financial planning, and market analysis. By understanding how psychological factors influence financial decisions, practitioners can develop strategies to mitigate biases and improve decision-making processes. Additionally, policymakers and regulators may use insights from behavioral finance to design policies that protect consumers and promote market stability.

Bibliometric analysis is a method that can be used to determine the progress of research in the field of behavioral finance. Using bibliometric analysis, researchers can examine the contents of bibliographies and analyze references used in articles published in journals and other scholarly sources. Findings examined using bibliometric techniques are valuable for a comprehensive understanding of the state, progress, and potential directions in the field, as well as for providing guidance for future efforts. Future research efforts[3].

Research on bibliometric analysis has been conducted extensively, including: bibliometric analysis in management business and STEM [4], bibliometric analysis in science education [5], bibliometric analysis in economics [6], [7], [8], bibliometric analysis of technology and the economy [9], bibliometric analysis of managerial finance [10], a bibliometric analysis on green finance [3] [11], a bibliometric analysis of financial literacy [12] [13], a bibliometric analysis on Islamic banking [14], and a bibliometric analysis on financial innovation [15]. Bibliometric analysis is a quantitative research method used to evaluate and analyze scientific publications, typically in the form of scientific papers, articles, books, and conference proceedings. This method involves examining patterns, trends, and relationships in a particular body of literature to gain insights into various aspects of academic research. Bibliometric analysis can provide valuable information about the impact of research, the productivity of researchers or institutions, and the evolution of scientific fields. Bibliometric analysis begins with the collection of relevant bibliographic data. This data typically includes publication titles, author

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443

names, publication dates, journal or conference names, citation counts, keywords, and abstracts.

One of the fundamental aspects of bibliometric analysis is the study of citations. Researchers analyze how often a publication is cited by other papers, which can indicate its impact and influence in a particular field. Citation analysis can identify highly cited papers and authors, as well as the flow of ideas and knowledge within the research community. Co-authorship analysis examines patterns of collaboration between researchers. It identifies who collaborates with whom and can provide information on research networks, interdisciplinary collaborations and the impact of key researchers. Researchers often estimate the impact of journals, conferences, or other venues of publication by analyzing factors such as the journal impact factor, the distribution of articles among journals, and the frequency of publications in specific venues.

Bibliometric analysis is used in a variety of fields, including science and technology studies, library and information sciences, and research evaluation. It provides researchers, institutions, funding agencies and policy makers with valuable insights to make informed decisions about research priorities and investments.

However, few have conducted research specifically mapping and analyzing bibliographic publication data that integrates the fields of behavioral finance and science technology to determine the evolution of this research. Analysis of research bibliographies especially for the last 10 years, from 2013 to 2022, using the VOSviewer application.

Therefore, this study aims to conduct a bibliometric analysis on a computer using VOSviewer software and publish or publish articles indexed by Google Scholar. We hope that this study can guide other researchers in finding new research topics related to the fields of finance and technology, especially the fields of behavioral finance and science technology.

2.   Method

This study used article data from journals indexed on Google Scholar. The reason we chose Google Scholar as our data source is that the database is open source. We used a reference management application called Publish or Perish to collect survey data. The Perish application is used to perform literature searches on selected topics.

Previous research has described detailed information on how to use and install the software, as well as the steps in the data acquisition process. [5] In addition, the study also provides detailed information on how to search for data in the library using Google. they learned This research involves several procedural steps, including: a) Crawling posts using the Publish or Perish app. b) preparation of bibliographic information of collected articles using Microsoft Exceed expectations application. c) Perform computational mapping on bibliographic distribution information using the VOSviewer application. d) analysis of the results of computer mapping.

To select publications that meet our title search needs, we use the Publish or Perish applications to search the article data. We entered the keywords "Behavioral Finance and Sci-Tech" and limited the publication period to 2013 to 2022. All the data we received was collected in June 2023.

Articles that meet the research analysis criteria will then be posted online in two different formats: Searching Information System files (.ris) format and comma-separated values files (.csv) format. VOSviewer is then used to describe and evaluate trends by forming a bibliometric map. Article data is obtained from database sources.

VOSviewer is used to create three types of post maps, namely network visualization, overlay visualization and density visualization based on the relationship between elements. When creating a bibliometric map, we set a frequency threshold for keywords to be included in the analysis at least three times. The result was 220 terms, and the least relevant keywords were removed from the map.

3.   Results and discussion

a.   Publication data search results

Using Google Scholar's Distribute or Die reference administration application, we effectively identified 801 articles that coordinated with our appearance parameters. The information we receive is in the form of article metadata, which includes various data such as author title, article title, year of publication, journal source, distributor, number of citations, article links, and related URLs. Table 1 illustrates some of the article information we used in the VOSviewer analysis for this review. We reviewed information from 20 articles related to the point question and a fairly high number of citations. Information on the behavior behind and distribution of science and innovation is provided in Table 1 below:

Table 1. Behavioral finance and science technologypublication of data.

No	Authors	title	year	brings	Refs
1	C Kearney, S Liu	Textual Disposition in Finance: A Survey of Methods and Models	2014	611	[16]
2	D. Hirschleifer	Behavioral finance	2015	572	[17]
3	RJ Schiller	Speculative pricing of assets	2014	502	[18]
4	Cherp et al	Integrating Techno-Economic, Socio-Technical and Political Perspectives on National Energy Transitions: A Metatheoretical Framework	2018	477	[19]
5	MD Kane, SB McKeon	CEO personal risk taking and corporate politics	2016	435	[20]
6	P Bordalo, N Gennaioli, Y Ma, A Shleifer	An overreaction in macroeconomic expectations	2020	434	[21]
7	K Birch, D Tyfield	Bioeconomy theory: biovalue, biocapital, bioeconomy or... what?	2013	431	[22]

8	K. Birch	Rethinking Value in the Bioeconomy: Finance, Activation and Value Management	2017	378	[23]
9	RD McLean, M Zhao	Business cycle, investor sentiment and expensive external finance	2014	373	[24]
10	T Renault	Intraday Online Investor Sentiments and Return Patterns in the US Stock Market	2017	330	[25]
11	S Bakar, ANC Yi	The Impact of Psychological Factors on Investor Decision Making in the Malaysian Stock Market: The Case of Klang Valley and Pahang	2016	323	[26]
12	MOR Prates, PH Avelar, LC Lamb	Assessing gender bias in machine translation: A case study with google translate	2020	321	[27]
13	M Giannetti, TY Wang	Corporate scandals and family stock market participation	2016	318	[28]
14	L Kengatharan, N Kengatharan	The Influence of Behavioral Factors on Investment Decision Making and Performance: A Study of Investors in the Colombo Stock Exchange, Sri Lanka	2014	317	[29]
15	J Engelberg, RD McLean, J Pontiff	Anomalies and news	2018	311	[30]
16	M Statman	Behavioral Finance: Finance with Normal People	2014	297	[31]
17	C Frydman et al	Using neural data to test a theory of investor behavior: A program for realizing utility	2014	268	[32]
18	S. Spiru	Herding in Financial Markets: A Literature Review	2013	259	[33]
19	A Masini, E Menichetti	Investment Decisions in the Renewable Energy Sector: An Analysis of Non-Financial Factors	2013	247	[34]

20	MJR Garcia	Financial education and behavioral finance: New insights into the role of information in financial decisions	2013	237	[35]

b.   **Research development in the fields of behavioral finance and scientific technology.**

The information in Table 2 provides an overview of the evolution of research published in journals listed on Google Scholar. Based on this data, approximately 801 research papers were published between 2013 and 2022. In 2013, there were 127 articles. In 2014, it had 114 articles. In 2015, the number of articles was 127, in 2016 there were 112 articles. In 2017, the number of articles was 105, in 2018 there were 80 articles. In 2019, the number of articles was 60, in 2020 there were 48 articles. The number of articles will be 20 in 2021, and 8 in 2022.

Based on the results of the analysis, it can be concluded that research on behavioral finance and scientific technologies continues every year. However, the development of this research also shows quite significant fluctuations, which can be seen in Figure 1. Over the past 10 years (2013-2022), there has been a decline as indicated by the number of publications.

Between 2013 and 2022, Figure 1 illustrates the development of research in the field of behavioral finance and scientific technology over the last ten years. "This figure shows that research related to behavioral finance and science technologies has decreased between 2017 and 2022.

The number of papers reached 127 in 2013 and 2015, but dropped to 112 in 2016. In addition, the development of behavioral finance and science and technology research has experienced a sharp decline in the last five years. There were 80 articles in 2018, 60 articles in 2019, 48 articles in 2020, 20 articles in 2021, and 8 articles in 2022. These data show that interest in behavioral finance and science and technology research is volatile and has declined in recent years.

Table 2. Development of behavioral finance and science technologies

year of publication	Number of publications
2013 year	127
2014 year	114
2015 year	127
2016 year	112
2017 year	105
2018 year	80
2019 year	60
2020 year	48

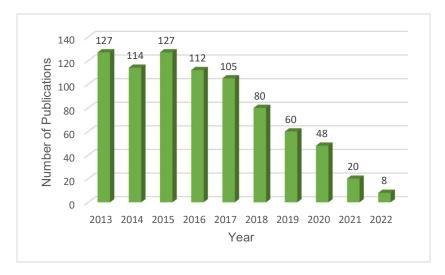| 2021 year	20
2022 year	8
all	801
average	**80.1**

fig. 1. Development level of behavioral finance and scientific technologiesresearch.

c.   **Behavioral finance and science technology topic visualization using VOSviewer.**

In the computational mapping process, we analyze the available article data. Computational mapping uses VOSviewer. Through this analysis, we found 220 items related to behavioral finance and science technology. This mapping data is then divided into 6 different clusters.

a)   Cluster 1, highlighted in green, consists of 85 items, activity, analysis, application, article, attention, author, behavior, behavior finance, case, child, China, concept, construction, country, covid, culture, data, debate, decision , development, economy, effect, energy, evidence, factor, finance, firm, form, frame, future, hand, idea, influence, meaning, meaning, India, industry, influence, information, innovation, insight, investor, investor sentiment, knowledge, last decade, level, life, literature, market, medicine, model, movement, nature, review, paper, part, patient, human, prospective platform, politics, power, relationship, relationship, research, robot, role, science technology , source, condition, stock price, research, survey, synthesis, system, technology study,term, theory, time, type, understanding, US, work, world, years.

b)   Cluster 3 consists of 37 items and is indicated in red, these 37 items are academic, achievement, belief, career, choice, college student, degree, difference, discipline, teacher, engineering, experience, female, gender bias, gender difference, gender gap, girl , individual, lack, longitudinal study, male, math, mathematics, motivation, need, participation, pbl, degree, retention, science, solution, stem, stem career, stem field, technology, underrepresented, female.

c)   Cluster 4 consists of 24 items and is highlighted in yellow, these 24 items are Attitude, Career Aspiration, Creativity, Curriculum, Effectiveness, Focus, Gap, Growth, Interest, Meta-analysis, Problem, Program, Project, Final Year, Robotics, School, Science Education, Skills, basic education, basic learning, student, student achievement, systematic review.

d)   Cluster 5 includes 24 elements and is indicated in purple, these 24 elements are approach, art, case study, challenge, context, demand, education, foundation, government, graduate, implementation, integrated foundation, integrated foundation educational, integration, link, literature review, practice, race, review, community, steam, steam education, context, education, foundation, graduate, implementation.

e)   Cluster 6 contains 2 elements and is distinguished by a light blue color. These 2 elements are perception and teacher.

Each cluster shows the relationship of one term to other terms. Each term is marked with a colored circle. The size of the circle varies according to the frequency of the term [5]. The size of the label in the circle shows a positive relationship with the frequency of the term in the title and abstract [36]. The more frequently a term appears, the larger the label size will be [5]. The visualization map in this study consists of three parts: network visualization (Figure 2), density visualization (Figure 3) and overlay visualization (Figure 4) [37]
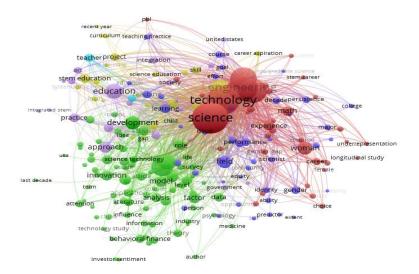

fig. 2. Network visualization of behavioral finance and scientific technologykeywords.

Figure 2 shows the relationship between these different terms. This network displays clusters of terms related to topics in behavioral finance, science, and technology that are often the focus of research. From the network visualization, we can see that behavioral finance and science and technology research can be divided into four areas: behavioral finance, science, technology, and science and technology. The terms behavioral finance and science and technology are grouped in cluster 1. The term behavioral finance is summarized in cluster 1, which contains a total of 66 links, a total link strength of 153, and 28 occurrences (Figure 1).

five). The term science and technology is then summarized in cluster 1, which contains a total of 46 links, a total link strength of 64, and 14 occurrences (Figure 6). The term science is summarized in cluster 3, which contains a total of 212 links, a total link strength of 2816 and 364 occurrences (Figure 7). The technologies are then combined into cluster 3 with a total of 208 links, a total link strength of 2590, and 323 cases (Figure 8).
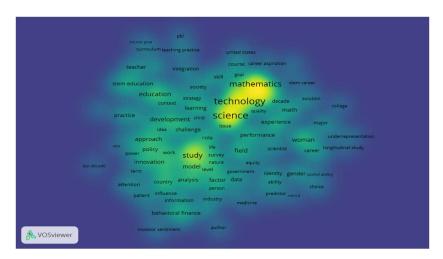

fig. 3. Visualization of Keyword Density in Behavioral Finance and Science Technology

Figure 3 illustrates the data density. This visualization illustrates that the brighter the yellow color and the larger the circle sign, the more common the term is in the study [5].

This shows that there are many studies that have investigated these related terms. Conversely, when the color of the term is closer to the background color, the term is considered less often. Based on Figure 3, relatively many studies have been conducted on terms such as science, technology, mathematics, and learning, while there are still fewer studies on behavioral finance. This allows researchers to conduct research in the field of behavioral finance in the future.
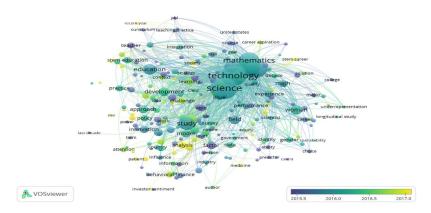

fig. 4. Visualize the overlap between behavioral finance and science technology keywords

In Figure 4 you can see a visualization of the overlap in the context of behavioral finance and science technology research. This visualization map provides an overview of the extent of research related to these terms that has been conducted in the field[36][37]. 4 and in more detail in 8, it can be seen that behavioral finance research is a research that has been widely carried out in 2017, this provides an opportunity for further research while the term scientific technology has been popular for a long time. Topics in Research. Thus, we can easily conduct new research related to behavioral finance and scientific technology.
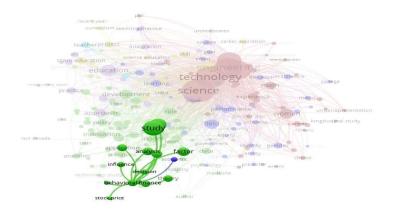

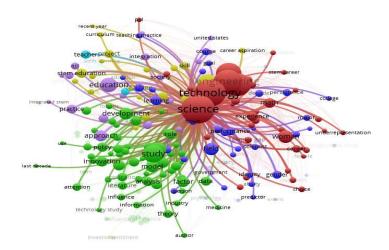**fig. 5. Visualization of the behavioral finance term network.**

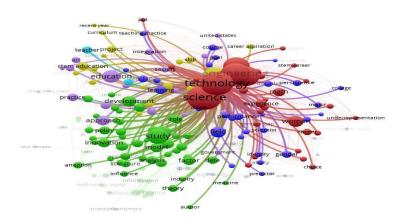**fig. 6. Network visualization of science terms.**

fig. 7. Visualization of the network of technological terms.

In Figure 5, you can see the network relationship between behavioral finance and several other terms, such as research, analysis, application, factor, influence, decision, theory, stock price, and economics. Meanwhile, in Figure 6, you can see the network relationship between the term science and other terms such as technology, engineering, education, development, research, model, innovation, approach, field, performance, experience, woman, gender, factor. , policy, practice, role, analysis, theory, math, data, information, personality, industry, identity, USA, last decade, focus, influence, predictive, career, integration, project, STEM, United States, course, skills, community , Teacher, Government, Medicine, Underrepresented, Basic, Resilience, Goals and Curriculum.

Based on this data, it appears that behavioral finance has less to do with other terms. In the maps, only 153 links are connected by 8 terms. On the other hand, the field of behavioral finance is more relevant and often associated with different terms.

This indicates that behavioral finance has great potential for further research and linking with other terms that can positively contribute to research innovation.
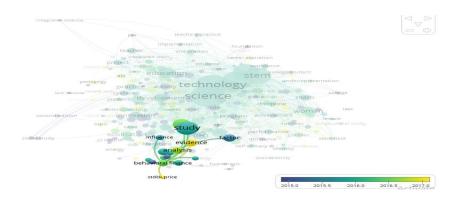

fig. 8. Visualization of behavioral finance term overlap in 2016-2017

The results of the mapping analysis of the collected article data show that the keywords behavioral finance and science technology are still relatively rare in research. Most research tends to use related terms or fields such as finance, behavior, science, and technology. Based on these findings, there is an opportunity to search for newer and more updated research on behavioral finance with scientific technology.

d. conclusions

The purpose of the study is to conduct computer mapping analysis of bibliographic data obtained from research articles. This research focuses on the topics of behavioral finance and science and technology. The data source comes from the Google Scholar database and is available through the Publish or Perish applications. The data used in this study consists of article titles and abstracts. The search results showed that 801 of his related papers were published between 2013 and 2022. According to the study, behavioral finance research declined from 2016 to 2022, peaked in 2014, and then declined again. The results of this study show that there is still room for further research on behavioral finance and linking it to other terms.

Acknowledgments

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Mr.Jitendra Manglani
Business, Management and Economics Engineering, 2023 Volume 21 Issue 2, ISSN: 2669-2481 / eISSN: 2669-249X

453

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