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Review

Entrepreneurial dynamics in the information age: A systematic literature review of research patterns and intellectual structures (2005–2024)

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Abstract: This systematic literature review examines the convergence of entrepreneurship and information technology between 2005 and 2024. It investigates how the emergence of information technologies such as social networks, smart devices, big data, and cloud computing have transformed business operations and entrepreneurial approaches. The study use technologies such as Bibliometrix to analyze academic literature and identify research trends, knowledge structures, and their evolutionary routes. During the specified time frame, a grand total of 292 articles were published by 777 writers. These publications have played a key role in redirecting academic focus from traditional entrepreneurship to the field of digital entrepreneurship and the applications of information technology. A thematic analysis uncovers a shift from theoretical investigation to practical implementations and multidisciplinary research, while a co-citation analysis highlights important contributors and influential works. This study emphasizes the crucial importance of information technology in influencing entrepreneurial behaviors and strategic business decisions. It also offers valuable insights for future research and entrepreneurial practice in the information age.

Keywords: systematic literature review; entrepreneurship; information technology; digital entrepreneurship; academic network structure

1. Introduction

The social networking sites, the use of smart electronic gadgets, and big data analytics and cloud computing infrastructures have not only changed the dynamic of the operation of the various enterprises but also the strategies that the business minds use to execute their commercial ventures (García-Lillo et al., 2023). These advancements have significantly altered the ways that data is collected, processed, and analyzed, enabling the business owners to accurately identify trends in the market and consumer preferences. Over the last few years, the sphere of information technology has offered the owners of businesses modern instruments and facilities that would allow for interaction with consumers, suppliers, and other participants of the company (Bandera et al., 2018). Therefore, when aiming to fully understand the essential features of the modern business environment, it is pivotal to analyze the relationship between information use and an entrepreneurial attitude (Ma, 2022). This research has provided a rich ground of knowledge of the effect of information technology on entrepreneurial behaviors and business strategies; it has provided the necessary knowledge to the entrepreneurs to maintain a competitive edge in this rapidly advancing age.

This study uses thematic analysis method to systematically review and critically discuss the academic literature exploring the link between entrepreneurship and

information technology. This study will be carried out between 2005 and 2024 to identify patterns in the dynamics of research evolution, configurations of knowledge, and developmental pathways of these areas. 2005 can be considered as the year of the major advancement in information technology where social networking sites began to spread widely and electronic devices with advanced features became popular (Crittenden et al., 2019). All these technological advancements have provided new opportunities for entrepreneurship innovations and business ventures (Barnett et al., 2019). The perception of such concepts as big data and cloud computing among the population signified the dawn of a new period in the management of information and the creation of original strategies in business processes. This change introduced a shift in how data is processed and used, resulting in a paradigm shift on how organizations use technology to gain competitive advantages and foster growth (Fornoni et al., 2012). While there may not have been a lot of articles published in 2005 but this year is considered as a significant year in the field of research about information technology and entrepreneurship.

The value of this research does not only lie in the analysis of the impact that information technology has on business behaviors and marketing approaches; it also covers the identification of potential future themes of collaboration research projects (Muratov, 2023). At the moment information technology stands as a crucial tool in the sphere of business as a tool which provides an entrepreneur with the means to outline opportunities on the market, make the proper decision, develop and maintain the relationship with the consumer, as well as participate in the networks. The application of information technologies in today's context enables the business persons to conveniently analyze and examine data in a more efficient and timely manner which, in turn, allows for improvements to be made.

Considering the fact that Scopus has been utilized as the focal academic database in the present investigation, the variability of the reported studies which actually provides coverage to multiple domains of interest in both the fields of entrepreneurship and information technology becomes comprehensively covered in the present investigation. This aspect of the Scopus database entails the use of scholarly journals, conference papers, and book chapters as sources of data ensuring reliability in the analysis conducted. The method for search included the two search terms, "entrepr*" and "informat*" used together with filter for document type of only academic and language of English only as to focus the discussion only on scholarly papers as much as is feasible and practical.

Furthermore, in this particular investigation, thematic instruments such as Nnivo were utilized to visually represent the citation relationships between various documents, pinpoint significant authors and publications in the specific research domain, and reveal intricate trends related to research themes and keywords. These analytical approaches contribute to an enriched understanding of the dynamics and knowledge structure underpinning research on the interplay between information technology and entrepreneurship, yielding fresh insights and offering guidance for prospective investigations in this.

The study takes into account the fact that information technology is changing very fast and includes in its coverage of emerging technologies such as IoT, Edge

Computing, NLP, Critical Robotics, AR/VR, Bio Tech Deepfakes Social Media. It touches upon their revolutionary effects on entrepreneurship, innovation and business models while at the same time dealing with moral/ethical issues that arise from technological advancements outperforming cultural, political or legal norms. The research is the proof of that how enormous a role responsible technology use plays in the aspect of innovation. Besides, it investigates how IT-enabled cultural changes such as the remote work and the multi-generational workforce dynamics with digital natives affect the entrepreneurial activities and technology adoption (Gupta and Bose, 2022). These main features make the research a complete when it comes to technology's participation in both current and future entrepreneurial projects.

2. Literature review

2.1. Application of systematic literature review in the intersection of entrepreneurship and information technology

With the rapid advancement of information technology, the interdisciplinary research domain at the intersection of IT and entrepreneurship is continuously expanding. The utilization of systematic literature review has emerged as a crucial instrument in this domain owing to its distinctiveness in unveiling academic progression patterns, research focal points, and knowledge frameworks. In this regard, systematic literature review provides academic researchers with a feasible structure to analyze literature data in order to detect the progress of the disciplines, trends, and fundamental issues. In the intersection of entrepreneurship and information technology, this analysis has identified the evolution of research interest, now moving from the trait approach involving character and behavior of the entrepreneur, or the adoption of information technology in entrepreneurship ventures, towards a new form of entrepreneurship in the digital age such as digital entrepreneurship (Baier-Fuentes et al., 2019; Tiberius, 2022; Thomas et al., 2021).

Originally, tentative research on systematic literature review was more about identifying key subjects and leading academics in the field. By analysing sheer data such as the citations of most popular literature and the authors' cooperation map, the researchers were able to uncover the knowledge base and the main directions of research in the interdisciplinary field of entrepreneurship and information technology. For example, Kuechle et al. (2016) discussed the various tactics that the entrepreneurs apply while in the prediction and the control aspect while dealing with uncertainty; information was described as central to the decision-making consideration among entrepreneurs (Abubakre et al., 2022). Over the years, with the enhancement of information technology the systematic literature review has shed the light on the transformation of the research domain in the field of entrepreneurship. At first, it dealt with historical events and concerned the personal traits and behaviour of the entrepreneurs and then the fact that how information technology contributes to identifying and utilizing business opportunities by the entrepreneurs and in the recent times, it has delved in to newer forms of entrepreneurship that are based on the information technology as presented by Wu et al. (2018) signifying the

drastic shifts in the landscape of this knowledge domain. Not only has the systematic literature review identified the academic advancement trajectories and knowledge systems in the field of entrepreneurship and Information technology, and its intersection but it has also seen the introduction and contribution to the improvement of research strategies, and development of theories in this field. Thus, systematic literature review is expected to remain integral and provide extensive backup in the disclosure of novel tendencies and theories in this interrelated field with the help of IT improvement.

2.2. Relationship between entrepreneurship and information

While discussing the process that takes place in the context of the information age entrepreneurship and information technologies interconnection reveals more and more complex and profound relationships. At the early stage, information technology was mostly viewed as a means to support more business like ventures as it could help the entrepreneurs in areas like analysing the market and dealing with customers (Wu et al., 2018). However, as innovations in technology and techniques as well as the advancement of digitalization, networking, and intelligent technologies were witnessed, this relationship began to change (Yang et al., 2023). Information technology not only impacted the way that new opportunities for the business were discovered and developed but also changed the nature of an entrepreneurship to its fundamental level (Kuechle et al., 2016).

In this transformational process, people started extending the theoretical applications of operating on uncertainties using prediction-based or control-based approaches. The above-mentioned strategies differ concerning the cognitive processes involved and the levels of interest elicited, whereby there are contrasting propensities toward risk (Kuechle et al., 2016). The choice of the strategies highlights the significance of IT in the decision-making process of entrepreneurs and IT encompassing ramifications on entrepreneurial actions and business advancement systems (Abubakre et al., 2022). The development of IT has also given birth to the latest forms of business organization such as platform-based models, crowdsourcing, and crowdfunding. Such emergent models depict how businessmen or women harness information technology to understand user needs, harness communal assets, and source funds through other unique approaches (Deng, 2022). Furthermore, the adoption of big data technology has enabled data-informed decision-making, thereby enhancing entrepreneurs' capacity to pinpoint and assess business opportunities (Deng, 2022).

The significance of information technology in high-impact entrepreneurship cannot be underestimated. By diminishing information asymmetries and bridging knowledge disparities, information technology bolsters the innovation process, creating room for growth for budding entrepreneurs (Bosman et al., 2022). The infusion of information literacy into the educational realm not only nurtures students' entrepreneurial mindset (Pardede and Lyons, 2012) but also furnishes them with the fundamental knowledge requisite for innovation and entrepreneurship (Bosman et al., 2022). This association has progressed from mere tool assistance to indispensable influence. The progression of digitalization, networking, and

intelligent technologies not only deepened this scholarly bond but also spurred innovation in entrepreneurship theory and application. Moving forward, with the continual advancement of information technology, research in this domain is anticipated to delve more profoundly, offering more comprehensive and insightful perspectives for the theoretical evolution and pragmatic implementation of entrepreneurship.

2.3. The role of information technology in promoting high-impact entrepreneurship

Information technology plays a pivotal role in the advancement of high-impact entrepreneurship within the contemporary landscape (Chen, 2014). As society progresses through the information age, the utilization of information technology becomes increasingly crucial as it offers unparalleled support to entrepreneurs (Johansson and Karlsson, 2022). This support is manifested through the reduction of information asymmetries and the bridging of knowledge gaps, ultimately enhancing the efficiency and widespread nature of the innovation process (Bosman et al., 2022). In this regard, the cultivation of information literacy has been deemed as a significant factor in fostering the spirit of entrepreneurship among the students (Orrensalo et al., 2022). It makes them aware of all the necessary knowledge that is required for carrying out innovation and entrepreneurship activities, and thus provides them a strong base for their further studies in the field of business.

The advancement of information technology, especially the availability of the internet, big data and artificial intelligence also brings in not only a number of resources and tools available to the entrepreneurs but also a change in the capability of the entrepreneur to process and manage information. This enhancement in information processing makes it possible for the entrepreneurs to identify market trends and consumers demands with better clarity, thereby improving the quality and efficiency of their decisions making (Graciela et al., 2016; Wu et al., 2018). For example, the integration of big data technology helps to make decisions based on data, providing businesspersons with efficient tools for analyzing and predicting market trends, which strengthens the ability to identify and evaluate business opportunities (Deng, 2022).

In the context of education, information literacy is one of the key components that hold a profound importance in the development of the students' entrepreneurial disposition. The incorporation of information literacy as part of the curricular offers students with the fundamental skills necessary for innovation and entrepreneurship while at the same time awakening their spirit and possibilities for entering the entrepreneurial world (Bosman et al., 2022). Notably, some studies that sought to advance knowledge on entrepreneurial education using information technology demonstrate that the use of information and communication technology enhances students' entrepreneurial learning process and enhances the development of their entrepreneurial skills and confidence (Wu et al., 2018).

Also, the creation of platforms for the dissemination of information on innovation and entrepreneurship (Kaiser and Kuckertz, 2023) also plays a major role in improving the effectiveness of the entrepreneurial education, thus the increase in

the success rate of entrepreneurial ventures (Ai, 2022; Deng, 2022). These platforms not only act as the channels through which the entrepreneurs and students are able to obtain and share innovative materials, but also enables the accumulation and sharing of knowledge, thereby reducing the barriers to the entrepreneurial initiatives, and in turn, enhancing the spirit of entrepreneurship among a wider population of people.

Thus, information technology plays a crucial role in supporting high-impact entrepreneurship as it reduces information deficiencies and facilitates knowledge gaps, enhancing the effectiveness of the innovation process. At the same time, the integration of information literacy and the promotion of the exchange of information for innovation and entrepreneurship not only provides entrepreneurs with necessary tools and knowledge but also enhances the quality of entrepreneurial education, which is crucial for the success of the ventures. In the future, as information technology evolves and becomes more integrated in the society, its impact in the development of entrepreneurship will be even more cemented.

3. Research methodology

3.1. Introduction

The preceding literature review has explored how information technology facilitates entrepreneurial spirit across various levels, and how the academic relationship between entrepreneurship and information technology has evolved over time. This paragraph review revealed the impact of information technology on entrepreneurial behavior and strategic decisions, from its early application as an auxiliary tool to its central role in identifying and leveraging opportunities, and how information technology deepens the relationship between entrepreneurial spirit and technology. Although a significant amount of research has focused on the intersection of the information domain and entrepreneurship, a comprehensive understanding of its academic development trends, core thematic evolution, and academic network structure is still lacking. In particular, discussions on systematically depicting the research trends during this period, identifying the interrelation of core themes and keywords within the research domain, and evaluating the academic collaboration models among key scholars, institutions, and countries within the field are still insufficient. The goal of this study is to deepen the understanding of the academic structure and development trends in the intersection of entrepreneurship and information technology during this period, thereby enhancing the systematic understanding of the academic network structure of this cross-domain. This will not only provide new insights for the academic community but also offer guidance for entrepreneurs and practitioners to succeed in this evolving field.

Research question 1: How have the research trends in the entrepreneurship and information domain evolved from 2005 to 2024?

By analyzing the publication volume, research hotspots, and key time nodes of the literature within this period, to depict the overall development trend of academic research within the entrepreneurship and information domain. This objective will provide a solid foundation for subsequent in-depth analysis, ensuring that we can accurately grasp the research dynamics within the field.

Research question 2: Which core themes and keywords have frequently appeared during this period, and how are they interrelated?

Through co-word analysis and thematic evolution analysis, to identify and map out the network of core themes and keywords within the field. This objective aims to deepen the understanding of the knowledge structure and thematic evolution of entrepreneurship research in the information age, revealing which issues have been particularly focused on by the academic community and analyzing the interrelation between these themes.

Research question 3: What is the academic network structure within the entrepreneurship and information domain?

By analyzing the main scholars, institutions, and countries within the field, as well as their collaboration models. Through constructing an academic cooperation network diagram, this objective aims to assess the distribution of academic influence and the paths of knowledge flow within the field, thereby identifying the academic centers and leaders who have made significant contributions to the research in this domain.

3.2. Research approach

To accomplish the aforementioned objectives of this study, this research utilized a systematic literature review method to evaluate the existing scholarly articles on the topic of entrepreneurship and information technology from the year 2005 to the year 2024. A systematic literature review involves clearly defining the research questions, establishing specific inclusion and exclusion criteria, conducting a comprehensive search across relevant academic databases, critically appraising and analyzing the selected studies, and systematically synthesizing the findings. This approach was chosen because it offers a step-by-step mechanism of searching, reviewing, and including pertinent literature on the given theme, thus offering comprehensive across-the-board understanding of the existing state and potential trends in the knowledge available.

3.3. Data collection

The data for analysis was collected from two of the most famous database, Google Scholar and Scopus which has ample number of indexed journal articles in all disciplines. The Scopus and Google Scholar database was chosen because these databases use accurate subject indexing and have powerful search tools, which is useful in the context of a thematic search. The search query was a combination of the keywords “entrepr*” and “informat*,” which allowed for the retrieval of relevant publications including various forms such as, “entrepreneur,” (or), “entrepreneurial,” (or), information” (and), informatics.” The search was limited to the documents that have been published in English and are of an academic nature, for example journal articles, conference papers and book chapters. This method was designed to cover the entire academic output of entrepreneurship and information technology while at the same time making it analytically feasible and in a way that excludes noise from non-academic sources. The first search delivered a count of 292 articles authored by 777 people, covering the time period from 2005 to 2024.

3.4. Research participants

The research subjects in the study were the authors of the published academic papers used in the dataset. This category of contributors includes academics from various disciplines, scholars, practitioners, and other people who have contributed to the field. Through evaluating the citation pattern, co-authorship networks, and thematic content of the publications within the research field, the aim of this study was to discover the major contributors, the works of influence, and the upcoming trends in the field of research. The analysis touched upon a range of authors who were of different institutes and locations across the globe, thus, depicting the global nature of academic research in this interdisciplinary area. It worth mentioning that the analysis of the authors' identities was conducted to find the collaboration patterns and the most influential figures, but the focus was on the collective body of work and not on the evaluation of individual researchers.

3.5. Data analysis

The collected systematic literature data was analyzed and processed by means of the Nnivo software package that is equipped with the tools for visualization and thematic techniques. Nnivo is the open-source tool that has been developed for carrying out a complete analysis of thematic data including, but not limited to, data cleaning, performance analysis and network visualization. This was a process of a number of analyses, each giving different pieces of information about the research landscape. The publication and citation trend analysis were the study of how yearly distribution of publications and citations were, to know the development of research interest and output within the field over time. The analysis of the research patterns, peak periods and possible factors that influence the productivity in this domain was given.

The co-word analysis in the study was able to detect and plot the co-occurrence of keywords which, through this process, revealed the main themes and their relationships. Through the examination of the frequency and co-occurrence patterns of keywords, this technique was able to reveal the main ideas, topics, and their interrelations in the literature. The study of thematic complexity through the analysis made by co-word method that follows the emergence, development and transition of key topics over time with the help of keyword analysis. This method made it possible to detect the research areas that were just about to emerge as well as those which had been existing for a long time and either remained or disappeared.

Co-citation analysis involved two aspects: author co-citation and documental co-citation. Author co-citation also recognized the influential authors by means of the citation links between papers, thus revealing who are the main researchers in that field and their effect on others. Document co-citation, in contrast to document citation, found highly cited publications and then mapped their citations links showing the most important works and research clusters. This analysis showed the basic and pioneering works that have greatly influenced the further research in this field.

Lastly, academic collaboration analysis visualized the networks of cooperation among authors, institutions and countries thus exposing the knowledge flows,

influential scientific centers and patterns of research cooperation. The research was focused on the study of these collaborative networks in order to detect the main hubs of research activity, the extent of international collaboration and also see if there were any specific people or institutions that played a role as bridges between different groups.

4. Results

An examination of the scholarly investigations conducted at the confluence of entrepreneurial studies and information technology spanning the period from 2005 to 2024 demonstrates an extensive body of work consisting of 292 articles authored by 777 individuals, yielding a combined tally of 4908 citations. On average, each article received 16.81 citations, while cited papers had an average citation rate of 23.15. The annual average citation rate stood at 272.67, with each author averaging 6.32 citations, highlighting discrepancies in citations among different authors and papers. Each paper had an average of 2.66 authors, indicating that collaborative research is characteristic of this field. The *h*-index is 34, indicating that at least 34 papers have received the same number or more citations, signifying the presence of a substantial number of core and influential research publications in the domain. The *g*-index is 64, demonstrating that some papers have a very high citation count. The *m*-index, at 1.79, signals a steady growth in the authors' influence over their research careers (see **Table 1**).

Table 1 provides an overview of the main information related to the publications analyzed in this study.

Table 1. Overview.

Main information	Data
Publication years	2005–2024
Total publications	292
Citable year	19
Number of contributing authors	777
Number of cited papers	212
Total citations	4908
Citation per paper	16.81
Citation per cited paper	23.15
Citation per year	272.67
Citation per author	6.32
Author per paper	2.66
Citation sum within *h*-core	4588
h-index	34
g-index	64
m-index	1.79

4.1. Research trends in the field of entrepreneurship and information

Figure 1 shows the total publication volume and total citations over the years.

In the contemporary era characterized by the proliferation of information, studies within the realm of entrepreneurship and information have demonstrated a favorable trajectory of advancement, indicating an increasing scholarly focus and research endeavors in this particular area as time progresses. The surge in academic interest and investigative undertakings in this field underscore the significance and relevance attributed to the intersection of entrepreneurship and information in the current landscape of knowledge production. From 2005 to 2024, the publication volume in the field of entrepreneurship and information has demonstrated a fluctuating growth trend (data from 2005 are not included due to a publication count of "0"). In 2007, there was a significant increase in publication volume from 2 papers to 5 papers compared to 2006, while the number of citations surged from 11 to 748 times, indicating the immense impact of certain publications that year. The growth in the following years was relatively stable until a notable rise in both publication volume and citations starting from 2018, especially peaking in 2021 with a total of 41 papers published. However, data from 2024 indicate a decrease in publication volume, which may relate to the timing of data collection or signify a change in research interest.

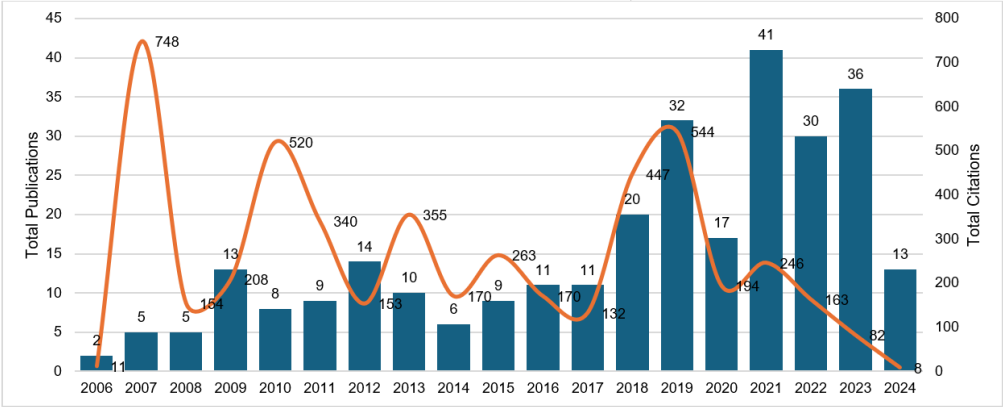

Figure 1. Total publication and total citation.

Variability in the citation rate gives an indication of the appreciation of the literature and the changes that occur with time. As for the citation rate, it is revealed that it does not have a steady increase in number per publication, which agrees with the results obtained in the year of 2023 where the average citation rate was found to have slightly declined in some areas. This phenomenon further points out how publication output is inversely related to the citation output, indicating that there is a need to explore the relationship between these factors. This may mean that the rise of the number of papers published is not always correlated with the improved impact or quality of those papers. It is a different index used to study the citations of scholarly products, and based on the information provided in this context, it is high in 2018 equal to 12, which got down to 1 in 2024. Variation in the *h*-index reveals density of easily identifiable articles within the given scientific field meaning high *h* values points to numerous articles in the field that receive significant citation. **Figure 1** schematically illustrates the tendencies within this field and demonstrates an increase in the number of publications over time based on their cumulative percentage. From the data trends in **Figures 2** and **3**, one can clearly observe that the overall

publication volume in this field is gradually rising periodically though there are fluctuations in the numbers in some years which may have been caused by variation in citation rates.

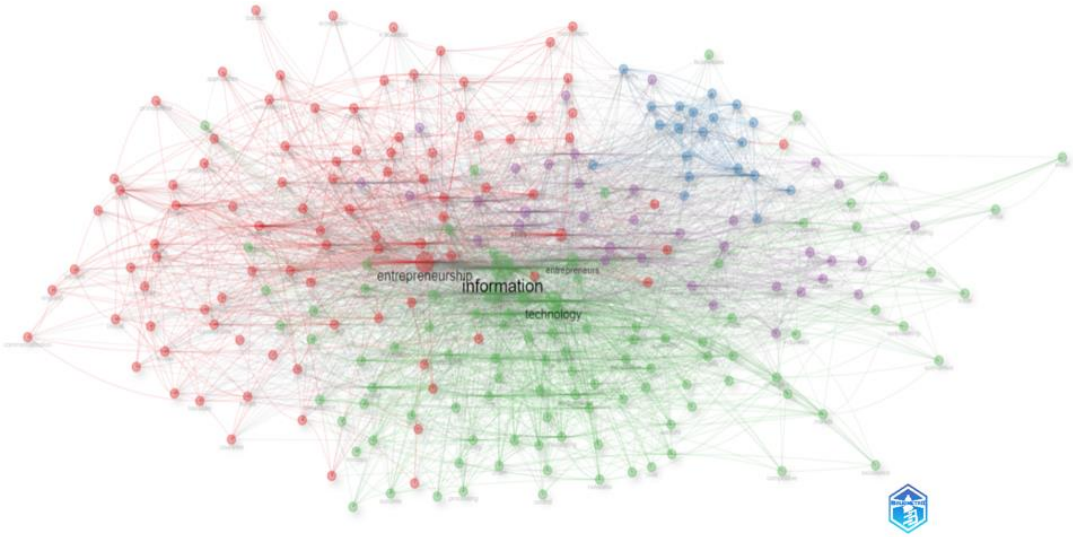

Figure 2. Core title.

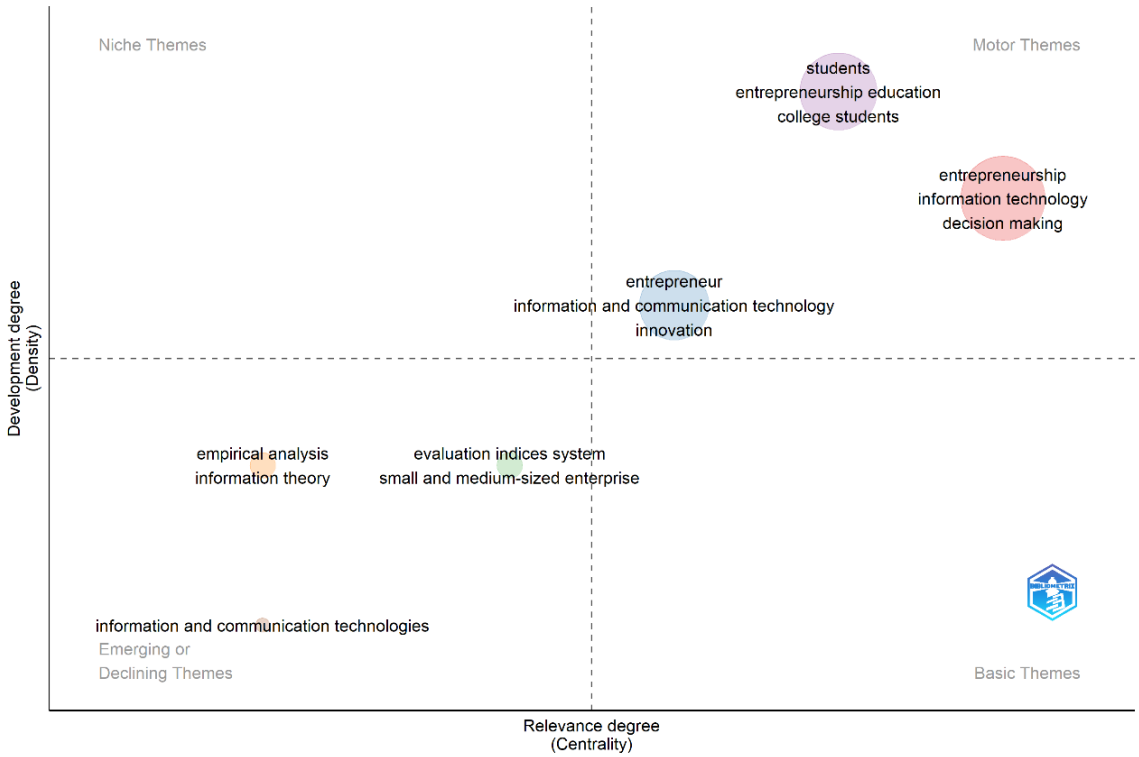

Figure 3. Keywords association.

When assembling the literature, there are of course specific themes that target which has remained the focus of several academics for years. For instance, one of the few published academic articles in the field by Keh et al. (2007) aims at investigating the relationship between entrepreneurial orientation and market information on the Small and Medium Enterprise (SME) performance, a topic that is of a paramount interest to both scholar and practitioner as it links strategies,

behaviors, and processes of firms with their performance results (Rehman et al., 2020). Another paper which having the sight of different region is the paper was written by Vaghely and Julien (2010) here refers to the processes through which an opportunity is created and the founding theory articulated by Alvarez and Barney (2007) and further developed by Davidsson (2015) refers to the continuous research interest on the ways entrepreneurs discover and build opportunities through information. These findings are supported by high citation counts for these articles, implying well-accepted status in the academic community and impactful contribution to subsequent studies.

Table 2 provides an overview of the top 10 most cited articles in the field.

Table 2. Top 10 citation article.

No.	Author(s)	Title	TC	C/Y
1	Keh et al. (2007)	The effects of entrepreneurial orientation and marketing information on the performance of SMEs	539	29.94
2	Vaghely and Julien (2010)	Are opportunities recognized or constructed? An information perspective on entrepreneurial opportunity identification	249	16.60
3	Varis and Littunen (2010)	Types of innovation, sources of information and performance in entrepreneurial SMEs	239	15.93
4	Autio et al. (2013)	Information exposure, opportunity evaluation, and entrepreneurial action: An investigation of an online user community	222	18.50
5	Steininger (2019)	Linking information systems and entrepreneurship: A review and agenda for IT-associated and digital entrepreneurship research	160	26.67
6	Vasilchenko and Morrish (2011)	The role of entrepreneurial networks in the exploration and exploitation of internationalization opportunities by information and communication technology firms	158	11.29
7	Chen et al. (2015)	Creative entrepreneurs' guanxi networks and success: Information and resource	123	12.30
8	Eckhardt et al. (2018)	Open innovation, information, and entrepreneurship within platform ecosystems	117	16.71
9	Todd and Javalgi (2007)	Internationalization of SMEs in India: Fostering entrepreneurship by leveraging information technology	107	5.94
10	Kwilinski et al. (2019)	Formation of the entrepreneurship model of e-business in the context of the introduction of information and communication technologies	102	17.00

The thematic development over the identified highly-cited publications indicates the shift in the focus of academic research from the conventional 'rags-to-riches' attitude toward entrepreneurship to information technology and digital entrepreneurship. The research by Autio et al. (2013) and Steininger (2019) show that current scholarship has paid more attention on how information systems support entrepreneurial actions and how digital is becoming essential to modern entrepreneurship. This transition not only shows that the research focus has expanded, but also highlights the importance of information technology in encouraging an entrepreneurial mindset.

The intensity of these publications also shows that the scholarly understanding of the role of information technology in entrepreneurship is also becoming broader and richer. Especially in the context of digitalization and globalization the internationalization of entrepreneurial activities and the change in the methods of innovation, about which Todd and Javalgi (2007) wrote in their work on internationalization of SMEs, and the study by Chen et al. (2015) of the relationship between innovative networks and success, illustrate the academic awareness of the

positive and negative correlation between entrepreneurial activity and information technology in the context of new economies.

Table 2 shows that the thematic development of articles published in highly cited journals indicates a change in the academic focus from the conventional entrepreneurial culture (Haar and White, 2013) to information technology and digital entrepreneurship (Helen et al., 2022). Autio et al. (2013) and Steininger (2019) reveal that there is a rising interest in the role of information systems in supporting and enabling entrepreneurial processes and how digitalisation is an essential feature of modern entrepreneurship. This transition also indicates that the topics of research have expanded in scope and shows the importance of IT in fostering entrepreneurial activity.

4.2. Core themes and keywords association

The identification of 'key words' and the co-occurrence data underscore "entrepreneurship" as the single most significant theme in the research studies, noting belongingness to the primary zone reflected in the greatest "betweenness." From it, it can be seen that the discussions in this field of education are mainly centered on the theme of entrepreneurship and its links to other themes. Another key feature of the term 's meaning is that it has a high "PageRank" value, suggesting that it is both common and important in the context of academic writing and research. Next to entrepreneurship, the terms "information technology", "information literacy", and "corporate entrepreneurship" are found to hold moderate "PageRank" values and are positioned in-between the terms; they appear to be relevant but are not directly at the nucleus of the research domain. One's significance over the other is further evidenced by their designation in academic research and learning as areas most relevant to the uptick of entrepreneurship; information technology and entrepreneurial education.

Therefore, it can be concluded that lower "PageRank" values of such terms as "information acquisition", "Information and communication technologies" (Lawal et al., 2022), and "library and information science" do not negate the importance of information gathering (Chen and Liu, 2023) and processing in the context of entrepreneurship studies. Their affiliations may suggest that they have accrued a more refined perspective towards the use of information work in entrepreneurial ventures with the advent of information technology. Relatively moderate 'PageRank' values assigned to words like 'innovation' as well as 'entrepreneurship education', when clustered together, indicate that they are gaining scholarly popularity as emerging concepts. Still, they are not as connected to the central node of "entrepreneurship" as one might expect: Although the occurrence of these themes has increased in research on entrepreneurship, their frequency and Google "PageRank" values suggest that these topics are becoming increasingly important in the subject, possibly pointing to emerging new research streams.

On this basis, the data suggests that all three constructs: entrepreneurship, education, and innovation are discussed and interconnected in the examined literature. The entwinement of these themes indicates how they have been co-produced in the academic discourse, demonstrating the symbiotic relationship in the

building of the knowledge architecture of the field of entrepreneurship. These findings are in line with the second research question and provide a more detailed view of the connections between the research themes through the quantitative analysis. To sum up, over the course of the research period, entrepreneurship has stayed constant as a key concept, which developed in relation to and in support of other concepts such as education and innovation. This synergy implies that entrepreneurship is not only an individual field of study but it is also an interface that promotes the development of knowledge in other fields of study. Therefore, the data conforms to the posed research question and offers a richer understanding of the thematic relation-ships through statistical analysis.

Figure 4 shows the transition of keywords from the period of 2006 to 2019 also from the year 2020 to 2024. Sustaining the interest besides reflecting an overall significant relevance of the keyword 'entrepreneurship' with the Weighted Inclusion Index of 0.66, this evidence indicates that, not only this type of papers was steady and highly active during all the years, but also significantly focused on the overall central research interests from 2020 to 2024. Nonetheless, Dell's Stability Index is lower at 0. According to the value 0.05, it is still possible that some subtle differences related to this theme might be observed. The presentation of new topics, for example, "information literacy" and "education for entrepreneurship", perfectly illustrate the need for education and efficiency of information processing means in molding future entrepreneurs among scholars. Particularly, the transition of "information literacy" from "business information" between 2006 to 2019 to its heightened role from 2020 to 2024 underscores the growing recognition and demand for information skills within entrepreneurial education.

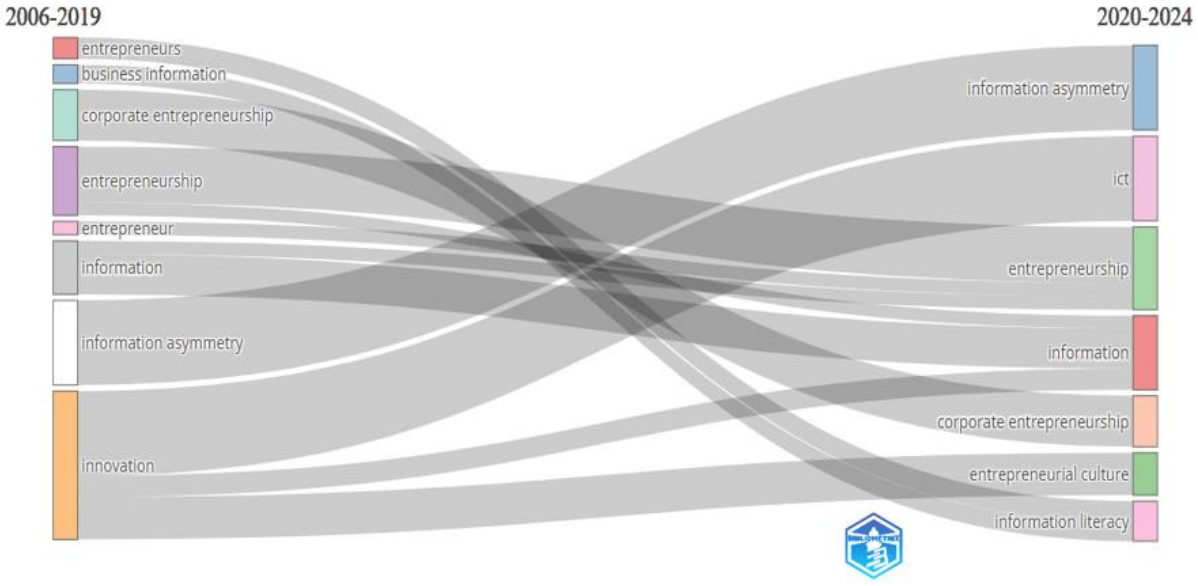

Figure 4. Thematic trends

Figure 4 illustrates the thematic trends and the relatively high stability indexes for "corporate entrepreneurship" and "information asymmetry" (both at 0.33), suggesting that these concepts have remained stable within the research domain and have continuously garnered attention across different periods. Such stability

indicates the enduring nature of certain core issues and theoretical frameworks within the field of study. The evolution of the keyword "innovation" shows a shift from a focus on innovation between 2006 and 2019, to its connection with "entrepreneurial culture," "ICT," and "performance" from 2020 to 2024. This suggests that innovation as a concept has expanded beyond product or service novelty to encompass discussions on corporate culture, the application of information and communication technologies, and their impact on business performance.

4.3. Academic network structure

4.3.1. Co-citation author analysis

As per to co-citation author analysis, there is a sequence of author who established considerable impact in the research area of entrepreneurship and information technology. The authors have produced many works that have become essential to the ongoing academic discourse within and across disciplines, which underlines their significant impact on the theoretical and practical development of the subject. **Figure 5** illustrates the co-citation network of these influential authors.

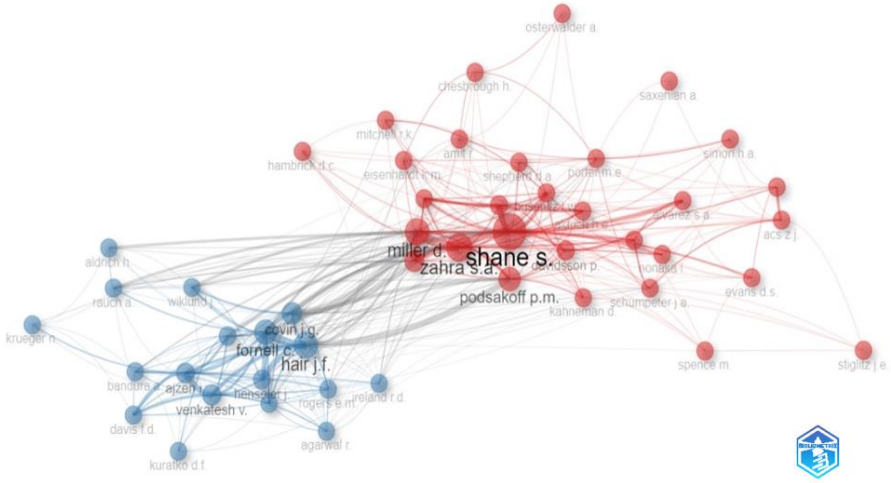

Figure 5. Co-citation authors.

For instance, Shane's (2003) work concerns primary areas of interest that include; The entrepreneurial process, opportunity identification, and utilization the subject elaborates on four key themes including; the entrepreneurial process, opportunity identification and utilization, and the information age and entrepreneurial behavior. Shane (2003) has also high overall centrality within co-citation author network which indicates his significant position in framework theory construction.

Through his proposed Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT), Venkatesh (2003) enriched our knowledge of how technology influences entrepreneurship and entrepreneurial actions. These models have not only reshaped information systems research field but also offered theoretical foundation for conceptualizing how new technologies are embraced by the entrepreneurs. Through her work, Zahra (1993) deepened the understanding of the field of entrepreneurship from the angles of international

entrepreneurship and corporate innovation capability, suggesting the importance of the entrepreneurial behaviour in the era of globalization.

4.3.2. Co-citation literature analysis

Further, **Figure 6** shows the co-citation literature analysis has deepened our understanding of academic contributions within the field, especially those key literatures that play a pivotal role in bridging different research themes and theoretical frameworks. For example, the notable articles, "Davis (1989)" on the Technology Acceptance Model and "Bandura (1997)" on the use of the self-efficacy theory, revealed that in the academic network betweenness measures were significantly higher basically meaning that they act as bridges for other contributions in the field of entrepreneurship and information technology.

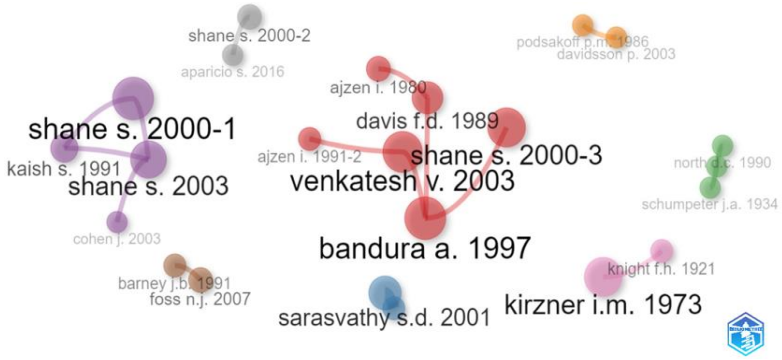

Figure 6. Co-citation literature.

Groups through co-citation analysis may represent different themes or theoretical streams: Behavioural theories, psychological factors, innovation, and technology transfer. This is not only shown in the fact that there is a versatile and rich variety of sub-themes within the field of entrepreneurship research but also in the interconnections between these themes.

4.3.3. Academic network structure and dynamics

Therefore, the analysis of a co-citation author together with literature analysis assists in gaining insights regarding the nature and development of the academic network in the field of entrepreneurship and information technology. These imply an overview of the key topics and the structures of power in the field and provide academicians with an insight into the processes that transpire in the given academic environment in the long term. Collectively these aspects enable a richer appreciation of the academic structure; identification of key players; as well as an understanding of how these contours come together to shape the knowledge system at the intersection of entrepreneurship and information technology.

The initial or seminal works which have laid the foundation and given direction to the stream of research as identified by co-citation and literature analyses are not only instrumental in taking the theoretical guidance of the field ahead but also offer great insights about how the entrepreneurs make sense of the opportunities in the environment which is getting enthralled with technology. These findings of research point to the fact that the emergence of IT, in fact, does not just revolutionize the ways of carrying out the business of entrepreneurship but also provides new

opportunities and challenges for the entrepreneurs.

In this sense, analyzing literature and identifying their co-citation, we can determine that such works as “Davis (1989)” as well as “Bandura (1997)” are significant for establishing interconnections between different topics and theories, and thereby creating the foundations for discussions and development of knowledge. The bridging function they fulfill underscores the significance of specific key literary works in establishing links among diverse research themes and theoretical frameworks in the domain of entrepreneurship and information technology. Through group analysis, we can discern distinct clusters that represent various research themes or theoretical orientations, unveiling the diversity and intricacy inherent in entrepreneurship research (Zhou et al., 2015), as well as the synergies and amalgamation between different research themes. This scrutiny not only elucidates the focal points and influence structures within the field but also underscores the evolving dynamics and interdisciplinary exchange within the academic network.

This scrutiny corroborates that in the contemporary era, where information technology holds escalating significance, the academic network structure in the sphere of entrepreneurship and information technology comprises a web of interconnected scholars, literary works, and research themes. These elements collectively delineate the academic landscape of the field, propelling theory advancement and fostering depth. Through a thorough examination of co-citation authors and literature, we not only enhance our comprehension of the academic framework and significant contributors in entrepreneurship research but also offer insights for forthcoming research endeavors, fostering the continued evolution of entrepreneurship theory and application in the digital age (Kwilinski et al., 2021).

5. Discussion and conclusion

5.1. Research trends and themes

After conducting an analysis of the literature encompassing the intersection of entrepreneurship and information technology spanning from 2005 to 2024, a myriad of research trends and thematic evolutions come to the forefront. Initially, the main focus of scholarly investigations revolved around delving deeply into the psychological foundations of entrepreneurial behavior, particularly honing in on the exploration of Bandura’s theory of self-efficacy. To be specific, it was more important to better understand the complex effects that this theory was able to demonstrate on the degree of confidence and the level of motivation provided by entrepreneurs. This avenue of research sought to explore the specifics of the ways various self-perceived abilities affect a person’s willingness to engage in enterprise and more specifically overcome obstacles to persist in business. It gave insight into the part autonomous image plays in the modeling of business behavior. Over time, there was a paradigm shift towards the appreciation of the relationship—demonstrable or hidden—between entrepreneurship and information technology (Chen, 2014). This shift was perhaps most notably articulated in the Technology Adoption Model by Venkatesh (2003) and in Shane’s (2003) accounting of the process of sensing entrepreneurial opportunities. It is for these reasons that over the last few years, attention has been focused on covering numerous topics for further

exploration which include; innovation, management of innovation, entrepreneurship and in particular how information technology affects business organizations. In addition, this change emphasizes the need to start taking into account the tendencies of technological progress and changes that occur in the relevant segments of business This is quite evident from the shift observed in the focus from more conventional, theoretical subjects to research on “information” and “information technology”. This may be attributed to the increasing awareness within the academic circle about the importance of technology for business and entrepreneurial processes.

Also, academe too shows evidence of a shift in focus from encapsulated discipline-based studies towards appreciating studies from other related fields and more and more scholars are trying to look for the link between of entrepreneurship with disciplines from education, psychology, sociology etc. This change in erudite positioning could reasonably be explained by the fact that knowledge economy is progressively emerging as a dynamic endeavor in the age of information, where managers and business owners are required to integrate knowledge from different fields to advance business and technology. Therefore, it is possible to notice that in the literature of this period, the subject matter moves from a focus on the theoretical discussion to the practical application of these concerns and, lastly, to an integration of different disciplines. It is also apparently demonstrated that the research domain has been gradually evolving and developing with the increase in expert understandings and maturity of the field and that the field of entrepreneurship is also highly adaptive (Moghavvemi et al., 2012) and has evolved with the change in the information age challenges. Through such changes in the course of their evolution, a broader picture appears indicating how the entrepreneurs are able to identify, and capitalize on fresh business opportunities amidst an environment that is constantly being shaped through advancements in technology (Wood and Pearson, 2009). Restructuring of knowledge that is being implied by the shifts of intellectual currents offers the guidelines for the future research directions in the field of entrepreneurship, especially in relation to technologies’ adoption and breakthroughs across disciplines.

5.2. The academic and practical significance of the research

Evaluating the thematic trend supports the impact of the main theories like the ‘‘Technology Acceptance Model’’ and ‘‘Opportunity Recognition Theory’’ on the SHI research. The theories developed under such distinguished authors as Shane (2003) and Venkatesh (2003) form the basis of future scientific studies as an important foundation for studying the methods of identifying and analyzing entrepreneurial opportunities in conditions of information over saturation. Concerning the development of these theories the subsequent angles and directions were introduced to the field of the entrepreneurship investigation starting from individual activity and behavioural notions up to the macro economic environments. The explanation of such incentive systems has provided a deeper understanding of the psychological and social factors motivating entrepreneurship, and as such, has transformed into an invaluable tool in modern entrepreneurship education and practice.

If in real life, these theories bear a critical role in guiding the entrepreneurs and innovators about how to speedily, respond to the dynamically changing technological environments (Stewart et al., 2008). For instance, Venkatesh's (2003) TAM model has garnered prominence and is used frequently by technology companies to gauge and assess customer uptake of innovative products. Similarly, Shane (2003) has inspired people into highlighting the need for not only responding to consumers' needs but also to consider social and ecological changes when expounding the value of open opportunities (Lakomaa and Kallberg, 2013) for entrepreneurial awakening. These theories, particularly when pragmatically applied, have advanced our knowledge of how mean business and informed the development of related policies and education.

Indeed, in the field of education, the incorporation of such theories into entrepreneurship brings great importance to educational institutions in developing the new generation of entrepreneurs. These theories are today being used in institutions of higher learning (Wu et al., 2018) to develop curricula that will help increase the student's creativity and their abilities to do business. Specifically, the use of successful practices that disseminate knowledge in integrating information technologies with business models helps students understand how technology can be leveraged to drive new innovations and business ventures in the modern world. Altogether, the utilization of these theories both in theoretical-empirical learning and pragmatic practice demonstrates the paramount importance of the application of active findings in research to practical interventions. As a step forward for information technology in international business, these theories are even more important for them and developing more and more IT efficient and dynamic entrepreneur.

5.3. Limitations and future research directions

Thus, despite all the affordances that scholars associated with the subject area of entrepreneurship and information technology have provided insightful findings, it is crucial to denote certain constrains that imply our study's limitations. Currently, recognizing specific limitations of our analysis is informative about future research prospects.

5.3.1. Limitations

Perhaps some of these issues could partially explain why the current analysis, relying on the co-citation and thematic evolution data derived from the existing literature, might not have gotten an ideal assessment of all the potential literature heterogeneity. Specifically, papers that have not been cited often or hot trends in scientific research which are only being studied at the moment can be excluded from the analysis, and this means that the trends in a specific field will not be understood fully. Secondly, this operation is based on particular databases and analysis instruments, which can cause restricted views and study depth. Distinctions between sources can lie in the parameters of some databases, and the choice of tools for the analysis may have an impact on the assessment of the results.

5.3.2. Future research directions

Adoption of interdisciplinary approaches: Due to the fact that this study is

situated in the field of entrepreneurship and information technology, it is recommended for future research to incorporate a wider range of theories and methodologies, exploring the concept of entrepreneurship from different approaches, such as sociological, psychological and economical.

Study of emerging technologies: Studying how these emerging technologies, such as artificial intelligence, blockchain, big data, influence the entrepreneurial processes and theories will be one of the essential avenues for future research. Namely, how these technologies change the existing patterns of opportunity recognition and resource acquisition warrants should be further investigated.

Exploration from a global perspective: Therefore, in order to understand the impact of globalization on entrepreneurial processes, it is crucial to investigate the nature of entrepreneurial behaviour in different cultures and economic environments; thus, the future research should focus on the analysis of how entrepreneurial behaviour depends on the cultural and economic context of countries, especially developing economies and emerging markets.

Connection between theory and practice: Going further into the connection between theoretical analysis and real-world knowledge, considering the ways in which theoretical conclusions can be applied in practice to help guide decision-making processes. This includes evaluating policies that aim at enhancing entrepreneurial education and support.

Through addressing these limitations and considering the directions for further research outlined above, the richness of knowledge in the field of entrepreneurship and information technology will be expanded, thereby encouraging theoretical development and improvement of practice. It will also create more solid foundation for the future entrants and at the same time it will open more research avenues and view points for the researchers.

5.4. Conclusion

Therefore, in an effort to identify the kind of information that can help support entrepreneurship, the study employed systematic literature review. This study entailed a detailed examination in order to determine shifts in the specific line of research, main topics and the characteristics of the academic network environment in this particular field. The subject of research in the context of ventureship has changed due to the qualitative changes associated with the rapid development of information technology. This shift has shifted away in the traditional idea where the key issues are identifying opportunities and resources procurement to more of theorisation on the advancement in technology and digitization. Additionally, the scenario of the academic network looked at the amount of interconnectivity and research cooperation in addition to the instantiation of multidisciplinary collaboration. These links and interactions are very important in supplementing theoretical content knowledge and providing help in practice. This paper shows that studying and supporting entrepreneurship, especially in the context of valuable information, it is possible to encounter a wide variety of subtleties and nuances, which require further research. Additional research is needed to address the details of the link between technological advancement and particular behavior of

entrepreneurship with concentration on comprehending the impact of globalization and social alterations to set up new types of entrepreneurship. Therefore, it is proposed that spotlight be placed on the increased utilisation of theoretical underpinnings and applied applications in the field including the future avenues of education and policy making. The proliferation of information suggests that such a focus is a challenge as well an opportunity; meeting these demands will be swift and efficient with such a focus. Thus, there is a possibility for enhancement of present theoretical knowledge on SME and also enhance the ways of offering better guidance and support for the entrepreneurial inclined individual.

Conflict of interest: The authors declare no conflict of interest.

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