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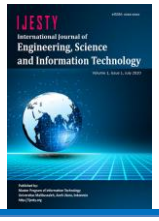

Impact of Information Technology: Developments the Related Research in the Last 2 Decades

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Abstract

This study outlines the potential future direction of research in Information Technology Impact. Based on current findings, we identify key areas where further investigation is needed to advance the understanding and application of Information Technology. Our discussion highlights gaps in the literature, proposes new methodologies, and suggests an interdisciplinary approach to answering unsolved questions. This research highlights the significant impact of information technology in improving operational efficiency and quality in the Education, health, and economic sectors over the past two decades. Using the PRISMA method for systematic literature analysis, this study identifies key trends and developments in information technology and provides recommendations for evidence-based practices and policies. The results of this study are expected to make an essential contribution to theory and practice, offering insights for more informed decision-making and more effective implementation strategies in the use of information technology.

Keywords: *Future Research, Impact of Information Technology, Research Gaps, Methodologies, Interdisciplinary Approaches.*

1. Introduction

Information technology's (IT) penetration and evolution have created significant transformations in various industrial, educational, and healthcare sectors in the last two decades. Information technology, covering everything from cloud computing to artificial intelligence, has become a considerable catalyst influencing how organizations work and how information is accessed and managed [1]. This research is essential because it allows for a deeper understanding of the broad impact of this technology, as well as the dynamics underlying its changes [2]. Given the rapid pace of innovation, it is essential to systematically assess how information technology has impacted operational and strategic aspects of various fields, thus providing a foundation for strategic decision-making and future policy enhancements [3] [4][5].

Recent research has shown various significant impacts of information technology in improving operational efficiency and effectiveness in multiple sectors. Implementing artificial intelligence systems in supply chain management has reduced operational costs by up to 30% in the manufacturing sector [6]. Cloud-based applications in educational institutions has improved the accessibility and quality of learning, allowing for a more inclusive and flexible approach to education [7]. These studies show how information technology plays a role in optimizing processes and redefining the work and learning paradigm. While there has been substantial progress, the literature also notes challenges such as data security issues and technology access gaps, which still need to be addressed further [8] [9] [10].

The study aims to provide a comprehensive and up-to-date analysis of the impact of information technology over the past two decades, focusing on three main aspects: Education, health, and the economy. Unlike previous studies focusing on just one sector or short-term impact, this study integrates multiple dimensions to assess how IT affects those sectors holistically and sustainably. In addition, by using the PRISMA method for systematic literature analysis, this research will identify and fill in gaps in the literature while providing recommendations for evidence-based practices and policies. Thus, the main contribution of this study is to provide a broader and structured view of the evolution and impact of information technology, supporting decision-makers in adapting technology for maximum benefit [11] [12].

The research question that leads to this study is, "How has the development and application of information technology affected operational efficiency, service accessibility, and quality in the educational, health, and economic sectors over the past two decades?" To answer this question, the study will use the Systematic Literature Review (SLR) method by following the PRISMA guidelines, including identifying, selecting, and critically analyzing relevant published studies. This analysis will not only allow the identification of key trends

and developments in information technology but will also illustrate how the changes have specifically affected the three critical sectors. The results of this study are expected to make an essential contribution to theory and practice, offering insights for more informed decision-making and more effective implementation strategies in the use of information technology.

2. Literature Review

Information technology (IT), which refers to using computers and software to manage information, has evolved significantly since the beginning of the 21st century. Cloud computing, big data, and artificial intelligence have transformed how business entities, educational institutions, and healthcare organizations access, process, and utilize data. According to Hashem et al. (2015), cloud computing has expanded data storage and processing capacity, allowing organizations to be more flexible and responsive to dynamic needs [13]. In addition, Cloud computing has a significant environmental impact due to the large power requirements for servers and other supporting infrastructure [14]. This study helps explain how sustainable IT infrastructure supports efficient global operations.

In the economic context, information technology has become key in optimizing business processes and improving strategic decisions through better data analytics, as explained by Janssen et al. (2017), who found that big data has increased efficiency in business decision-making [15]. Meanwhile, in the health sector, Mohammadzadeh et al. (2022) highlight how telemedicine has opened access to healthcare, especially in remote areas [16]. In the field of Education, information technology has facilitated the transition to hybrid and online learning models, which significantly expands the reach and accessibility of Education [17].

The evolution of information technology also brings challenges, especially related to data security and privacy. As pointed out by Kong et al. (2018), the increase in cybersecurity incidents has created a need for more robust security strategies [18]. Although information technology provides many advantages, gaps in access and technological capabilities remain essential, especially in developing countries. This discussion is vital to understanding the balance between technology adoption and associated risk mitigation, which will continue to be a significant focus in IT research and implementation in the future [19].

A recent study by Hwang and Kim (2021) shows that adopting information technology in the manufacturing sector has increased production efficiency by up to 26% through automation and system integration [20]. The research highlights the importance of advanced IT infrastructure in facilitating process automation and waste reduction. Meanwhile, Abri and Mahmoudzadeh (2015) identified that although the initial investment is significant, the return on investment in information technology can be evident in the long term in the form of increased productivity [21].

In the context of Education, information technology has provided significant changes in teaching and learning methods. Research by Ravi et al. (2021) illustrates how digital learning platforms have expanded access to Education in remote areas, allowing students who previously did not have access to quality education to take online courses from leading universities now [22]. However, Joshi (2023) notes that the digital divide is still a significant obstacle, with students from low economic backgrounds often not having access to adequate technological resources [23].

A study by Walker et al. (2020) explored the implementation of electronic medical record systems in hospitals, showing significant improvements in administrative efficiency and diagnostic accuracy. The study also criticizes that not all healthcare facilities are equipped to manage large volumes of data, often requiring system upgrades and personnel training [24]. Mishkin et al. (2022) added that telemedicine has become critical during the COVID-19 pandemic but faces challenges regarding patient data privacy and security [25].

Although many studies have revealed the benefits of information technology, there is a research gap related to the long-term impact of this technology on social and economic well-being. For example, a study by Nieminen (2016) shows that information technology often widens the digital divide and exacerbates social inequalities, underscoring the need for a more inclusive and holistic approach [26]. Ciulli et al. (2023) also found that many companies fail to integrate information technology with sustainable business strategies, often resulting in inefficient or unsustainable solutions [27]. This research shows the need for a more holistic and integrated approach that considers information technology's social and environmental aspects [28].

An in-depth literature review has identified that while information technology has provided many benefits, some areas remain unexplored, especially cross-sectoral integration and its long-term impact on social welfare. This research will develop a framework that integrates theories from economics, health, and Education to form a comprehensive model that holistically assesses the impact of information technology. Focusing on longitudinal data integration and cross-sectoral analysis, the framework will enrich the understanding the dynamics between technology adoption and key outcome variables across the three sectors.

This study aims to address several essential gaps identified in the literature review, such as the lack of data on the influence of information technology on the economic resilience of specific sectors and the effectiveness of hybrid education approaches in improving learning outcomes. Using the systematic PRISMA method for literature review, this study will consolidate findings from multiple sources to build a stronger understanding of the factors that affect the effectiveness of information technology [29][30]. Furthermore, it will explore how technology can be adapted to maximize positive impacts while minimizing adverse effects, particularly in improving accessibility and inclusivity in the health and education sectors.

3. Research Method

This study aims to examine a collection of scientific articles that discuss research trends related to "Impact" AND "information technology," which have been published in reputable international journals with the Scopus index. Scopus is one of the most extensive and comprehensive sources of citations and has an abstract database of peer-reviewed literature, such as scientific articles, books, and conference proceedings [31]. In addition, the review article in this study is also intended to conceptualize the study of "Impact" AND "information technology" through the research question, "How has the development and application of information technology affected operational efficiency, service accessibility, and quality in the education, health, and economic sectors over the past two decades?". This question will be explained through data findings and discussions of data processing results using VOSviewer software.

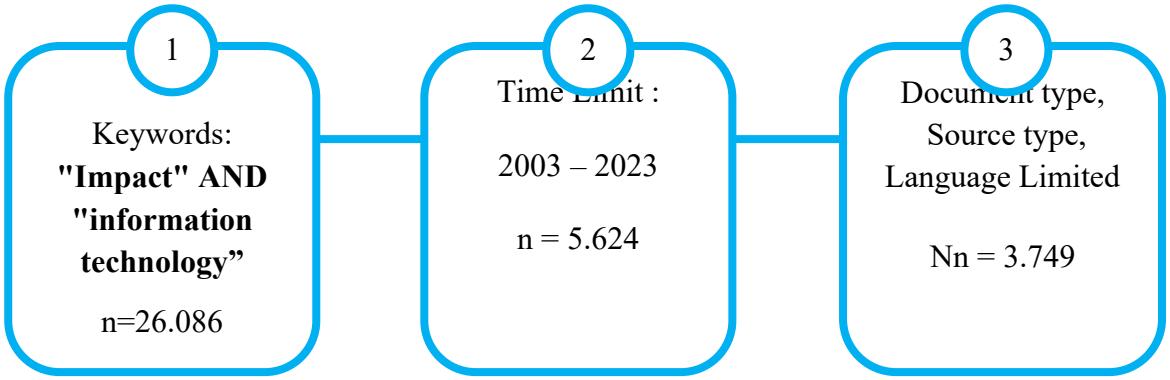

Fig 1. Data Filtering Step. Source: Created by the Author

Furthermore, the research data was taken from the Scopus database through several stages. In the first stage, researchers categorized searches using two keywords, "Impact" AND "information technology," identified by categorical title, abstract, or keyword, resulting in 26,086 documents. In the second stage, the researcher limited the time by modifying the database search to 5 years from 2003 to 2023 and selecting only journals with all open-access categories. At this stage, 5,624 documents were generated. Then, in the third stage, the author determines the focus of the type of document to be analyzed, namely the type of article, which then produces 3,992 papers.
Furthermore, the authors limited the source type to only come from journals, resulting in as many as 3,947 documents. Subsequently, the author limited the articles to only English, resulting in 3,749 papers. So, as many as 3,749 final documents obtained will then be analyzed.

4. Result and Discussion

4.1. Trend Analysis Based on Annual Data

An analysis of publication trends over the past two decades revealed a significant increase in scientific works related to information technology, with general trends showing consistent growth.

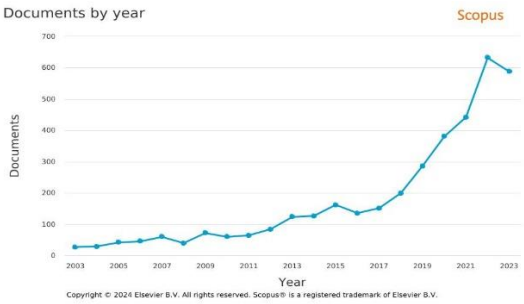

Fig 2. Publication trends by year. Source: Scopus Database

Based on figure 2, from 2003, with only 27 publications, the number increased significantly to 632 publications in 2022. This increase reflects the exponential growth in research interest and investment in information technology. Despite the annual fluctuations, such as declines in 2016 and 2019, the general trend still increased. These changes can be attributed to several factors, including global events such as economic crises or pandemics, which often affect the focus and funding of technology research [32]. The latest peak in 2022, the most significant number in two decades, signals an era in which information technology is increasingly at the center of innovation and development in various sectors [33]. This analysis not only underscores substantial growth in IT research but is also essential in understanding how these trends may affect strategies and policies related to the future application of information technology.

4.2. Country-Based Analysis

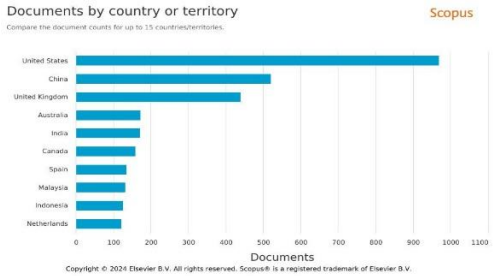

Fig 3. Publication trends by country. Source: Scopus Database

Based on Figure 3, the distribution of publications by country shows that the United States has the most significant number of publications, reaching 968, followed by China with 519. These two countries significantly dominate information technology-related research, demonstrating their role as global innovation and technology centers. The UK also has 438 publications, confirming its position as a European research leader.

Other countries such as Australia, India, and Canada also show strong contributions, with more than 150 publications each, reflecting extensive global involvement in information technology research. Meanwhile, countries such as Spain, Malaysia, Indonesia, and the Netherlands each produced more than 100 publications, showing that research activities in information technology are concentrated in countries with advanced economies and extend to developing countries.

4.3. Analysis by Affiliate

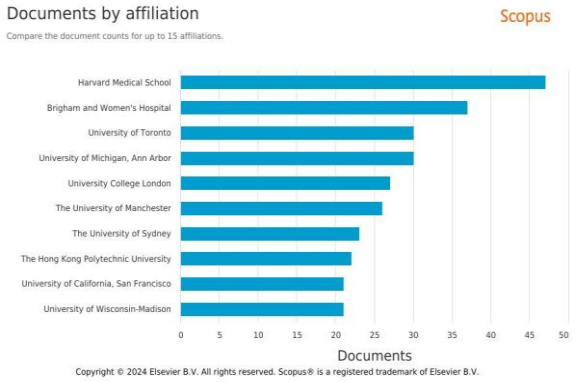

Fig 4. Distribution of publications by affiliation. Source: Scopus Database

Based on Figure 4, the distribution of publications by affiliation reveals the dominance of some leading institutions in information technology research. Harvard Medical School leads the way with 47 publications, followed by Brigham and Women's Hospital with 37 publications. These two institutions, along with the University of Toronto and the University of Michigan, Ann Arbor, each with 30 publications, demonstrate the critical role of higher education institutions and medical centers in developing and implementing technological innovations.

Furthermore, University College London and The University of Manchester in the UK produced 27 and 26 publications, respectively, confirming their role as crucial European research centers. In Asia, the Hong Kong Polytechnic University has 22 publications. The University of California, San Francisco, and the University of Wisconsin-Madison, each with 21 publications, also showed significant contributions in the United States.

Analysis by Subject

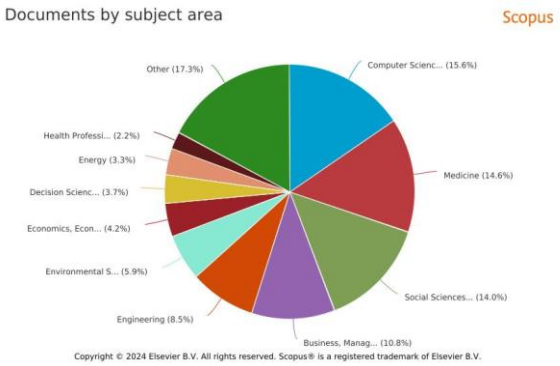

Fig 5. Analysis by Subject. Source: Scopus Database

Based on Figure 5, distribution of publications by subject, Computer Science dominates with 1129 publications, emphasizing the importance and centrality of information technology in this discipline. With 1056 publications, Medicine also stands out, illustrating the deep integration of information technology in modern medical practice. Social Sciences followed with 1017 publications, which showed the widespread application of information technology in understanding and solving social problems.

In addition, Business, Management, and Accounting show the significance of information technology in business management with 781 publications, while Engineering with 614 publications highlights its use in design and technical innovation. Environmental Science and Economics, Econometrics, and Finance are also important areas, with 429 and 304 publications, respectively, reflecting the influence of information technology on sustainability and the economy [34].

4.4. Development and Application of Information Technology in the Education, Health, and Economic Sectors

Over the past two decades, the development and application of information technology (IT) has brought significant changes in various sectors, including Education, healthcare, and the economy. Based on data analysis processed using VOSviewer, trends, influences, and relationships between topics relevant to the research questions the researcher has asked can be identified.

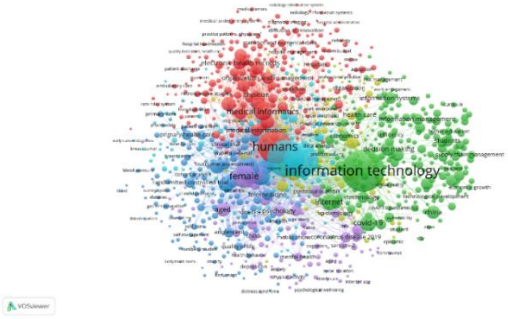

Fig 6. Network Visualization

Based on Figure 6, the network visualization generated by VOSviewer, it is clear that the topic "Information Technology" is at the center of the network, showing its central role in various research. The green cluster, which dominates visualization, covers topics such as "Information Systems," "Decision Making," and "Health Care," indicating that IT has been widely adopted and has had a significant impact on a variety of operational and managerial contexts [35].

Information technology has improved operational efficiency in the education sector by implementing learning management systems, computer-based evaluation tools, and distance education platforms. Research in this cluster shows that the integration of IT in the education sector has improved the accessibility of education services, enabling more flexible and inclusive learning [36].

IT has played an essential role in developing Electronic Health Records and Clinical Decision Support Systems in the healthcare sector, significantly improving healthcare quality and operational efficiency [37]. The associated clusters show strong links to topics such as "Medical Informatics" and "Electronic Health Records," which emphasize the importance of IT in improving accuracy, data management, and clinical decision-making [38].

Meanwhile, in the economic sector, the adoption of IT has changed the way businesses operate, with topics such as "E-commerce," "Cloud Computing," and "Information Systems" demonstrating the widespread adoption of IT to improve operational efficiency and service quality. Network visualization shows that IT serves as an operational tool and a driver of innovation and economic growth [39].

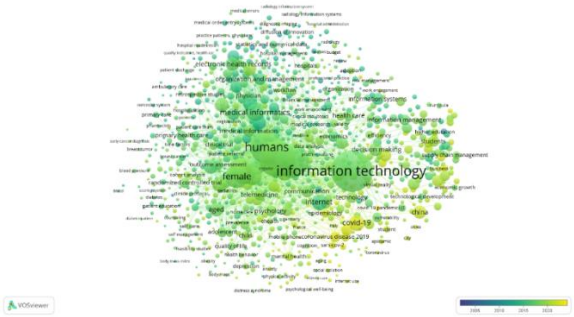

Fig 7. Overlay Visualization

Based on Figure 7, the visualization overlay provides a temporal picture of how the focus of the study has evolved. In the last decade, there has been an increase in research on topics such as "Big Data," "Artificial Intelligence," and "Cloud Computing". This shows that recent developments in IT are increasingly focusing on data analytics and cloud-based technologies, which provide new capabilities to improve efficiency and quality of service across various sectors.

In the education sector, in the early period (2003-2010), research mainly focused on the development and application of basic digital learning methods such as "E-learning" and "Online Education" [40]. The study covers how technology can deliver educational materials and efficiently increase student engagement. Over time, between 2010 and 2015, the focus of research shifted to the development of more interactive and adaptive learning platforms, such as Learning Management Systems (LMS) and the use of multimedia in Education [41][42]. In the most recent period (2015-2023), recent research highlights innovations in distance learning and technology-based Education, including the use of learning analytics for learning personalization, the development of MOOCs (Massive Open Online Courses), and the application of virtual reality and augmented reality technologies in Education [43][44]. This research shows that information technology has improved flexibility, accessibility, and overall quality of Education.

In the health sector, in the early period (2003-2010), research mainly focused on implementing and adopting electronic medical record (EHR) systems. It covers how EHRs can efficiently manage patient data and improve healthcare quality [45]. Over time, between 2010 and 2015, the focus of research shifted to the advanced benefits of EHRs, including integration with clinical decision support systems (CDSS) and using health data for better clinical decision-making. In the most recent period (2015-2023), recent research highlighted EHR interoperability, data security, and the use of big data for predictive analytics and healthcare personalization [46][47].

In the economic sector, in the early period (2003-2010), the research mainly focused on the early adoption of information technology in business, such as the application of management information systems (MIS) and the basics of e-commerce [48]. The research covers how technology can improve operational efficiency and expand markets. Over time, between 2010 and 2015, the focus of research shifted to developing more sophisticated technologies such as the "Digital Economy" and applying big data technology in business analytics [49]. During this period, research also explored new concepts such as the sharing economy and technology integration in the supply chain. In the most recent period (2015-2023), recent research highlights blockchain and fintech technologies used to improve transparency, security, and efficiency in economic transactions [50]. Additionally, there is an increase in research on the use of artificial intelligence (AI) and automation in business operations, which allows businesses to operate more efficiently and offer a higher quality of service. This research shows that information technology has created a more efficient, safe, and innovative economic system.

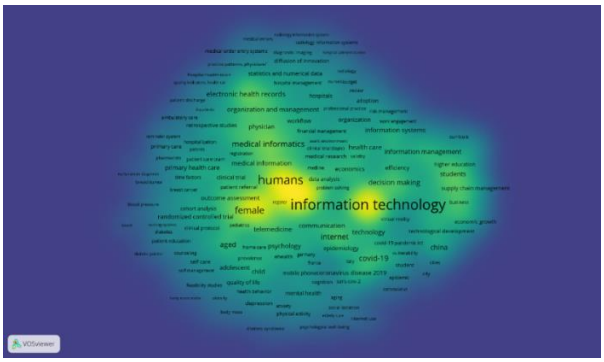

Fig 8. Density Visualization

Based on Figure 8, the density visualization provides insight into the density of research and the most explored areas in the last two decades. High-density areas around the topics of "Information Technology," "Medical Informatics," and "Electronic Health Records" show a high concentration of research focused on the application of IT in improving operational efficiency and service quality in the health sector.

In the education sector, density visualization reveals that topics such as "E-learning" and "Online Education" have a high research density. This area has been a primary focus in the last two decades. Early research focused on developing and applying technology to provide learning materials digitally, while more recent research explored more interactive and personalized learning methods. The high density on this topic reflects how digital Education has become essential, allowing for broader access and flexibility in the teaching and learning process [51]. Additionally, learning analytics for learning personalization shows increased interest in understanding how students learn and how technology can be adapted to meet individual needs [52].

In the healthcare sector, density visualization shows that topics such as "Electronic Health Records (EHR)," "Medical Informatics," and "Telemedicine" have very high density. EHR and Medical Informatics are central to many studies, reflecting the importance of efficient and accurate health data management. Research related to EHR focuses on how this system can optimize patient data management and improve the quality of healthcare services. Telemedicine, which also stands out in density visualization, shows a massive increase in research and application of technology to provide telehealth services, especially in remote areas. The high density of research on these topics shows that information technology has become very integral in improving the accessibility, efficiency, and quality of health services [46].

In the economic sector, density visualization highlights topics such as "Digital Economy" and "Blockchain" as areas with high research density. This reflects how information technology has been widely adopted to improve efficiency, transparency, and security in economic transactions. Early research in the digital economy focused on applying information technology to transform traditional business models into digital. The high density of research on blockchain shows the growing interest in this technology to create a more secure and transparent economic system [50]. Additionally, using big data and business analytics in research reflects how companies leverage data to make better decisions and optimize their business operations [49].

4.5. Challenges and Considerations

Research on the impact of information technology on operational efficiency, service accessibility, and quality in the Education, health, and economic sectors faces several challenges and considerations.

One of the main obstacles in the education sector is the digital divide. Students from low economic backgrounds often do not have access to adequate technological resources, which hinders their ability to fully utilize learning technologies such as e-learning and online Education [53]. Density visualization reveals that such issues as "E-learning" and "Online Education" have a high research density, reflecting the importance of these areas in the last decade. In addition, there are ethical considerations related to student data privacy in digital learning platforms [54]. Policies that ensure equitable access to technology and strict data protection are needed to address these challenges, as well as funding programs that can help schools in underprivileged areas.

In the Health sector, patient data privacy and security are significant challenges, especially with the increasing use of Electronic Health Records (EHRs) and telemedicine. Health data leaks can have serious consequences, making it essential for researchers and healthcare practitioners to implement strict security protocols and comply with privacy regulations such as GDPR. Density visualization shows that such issues as "EHR," "Medical Informatics," and "Telemedicine" have very high densities, indicating a significant focus in this study. In addition, limited funding can also be an obstacle to adopting advanced health technology in small health facilities and remote areas. Kannoju (2010) highlights how telemedicine has opened access to health care, especially in remote areas [55], but also emphasizes patient data privacy and security challenges. Strategies to address this include seeking collaboration with the private sector and government to obtain funding and ensure adequate training for health workers.

The main challenge is ensuring security and transparency when applying blockchain and big data [49]. This technology can improve operational efficiency and transaction transparency, but it also carries risks related to data security and potential misuse. Early research in the digital economy and blockchain shows that these technologies have been widely adopted to improve efficiency, transparency, and security in economic transactions. Researchers must develop methodologies that ensure data security and adhere to ethical standards. Jansen (2017) found that using big data has improved efficiency in business decision-making but underscored the importance of strong data protection [15]. In addition, funding limitations for research and adoption of new technologies can be overcome through collaboration with industry and government agencies to obtain financial support.

Future research must leverage innovative methodologies such as big data analysis, machine learning, and longitudinal studies to identify patterns and trends that can improve efficiency and quality across all three sectors. An interdisciplinary approach is also essential to provide comprehensive insight into the impact of IT and develop effective and sustainable solutions. By integrating these methods, research can better explore and maximize the positive effects of information technology while addressing existing challenges. A more in-depth study of cross-sectoral integration and the long-term impact of informationtechnology on social well-being is also needed to provide a more holistic understanding of the dynamics of technology adoption in various fields.

5. Conclusion

This study examines the impact of information technology (IT) development and application on operational efficiency, service accessibility, and quality in the Education, health, and economic sectors over the past two decades. The analysis results show that IT has significantly changed all three industries. In Education, technologies such as e-learning and online Education have increased the flexibility and accessibility of learning, although challenges such as the digital divide remain. In the healthcare sector, using Electronic Health Records (EHRs) and telemedicine has improved the quality and access to healthcare services, especially in remote areas. However, they still face data privacy and security issues. Meanwhile, in the economic sector, technologies such as blockchain and big data have improved operational efficiency and transaction transparency, although attention is still needed to data security and funding limitations. As such, IT has proven itself to be a key driver of innovation and quality improvement across various sectors, although ethical challenges, data accessibility, and funding must continue to be addressed to maximize their positive impact in the future.

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