AUTHORSHIP PATTERN IN PUBLICATION PRODUCTIVITY OF COMPUTER SCIENCE RESEARCHERS IN NIGERIAN UNIVERSITIES

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Abstract

The research investigates the trends, challenges, and factors that influence the authorship patterns and publication productivity of computer science researchers in Nigerian universities. Data collected from the publications produced within the period of 2005 to 2014 indicates that collaborative authorship is the dominant trend; a small research team consisting of two or three authors has produced the majority of the publications. This reflects the multidisciplinary nature of computer science and the need for diverse expertise to address complex research challenges. Larger teams, though less common, make significant contributions in emerging fields such as artificial intelligence and machine learning. Key findings place institutional factors at the center, including funding and technological infrastructure, in shaping research productivity. Limited resources in most universities in Nigeria make necessary international collaborations, which can also sometimes be a source of unequal authorship. Likewise, the participation of women, whether in number or in relevant author positions, is minor compared to that of men-a situation that underlines further the issue of diversity and inclusion. Moreover, early-career researchers, despite playing pivotal roles in publications, often face challenges in gaining due recognition that affects their career trajectories. The study concludes that addressing these challenges requires targeted interventions, including increased funding, improved access to research infrastructure, and the implementation of fair authorship policies. Promoting gender equity and supporting early-career researchers are critical for enhancing inclusivity and sustaining research productivity. By adopting these measures, Nigerian universities are better positioned to make valuable contributions to computer science research efforts globally and promote a more equitable academic environment.

Keywords: Authorship Patterns, Collaboration, Computer Science Research, Nigerian Universities and Publication Productivity

Introduction

The academic productivity of researchers in Nigeria, especially in the field of computer science, has generated immense interest in recent times, given its importance for national development. Scholars, particularly in the field of computer science, are deeply involved in conducting extensive research and publishing their results in local and international journals within Nigerian universities. However, the authorship patterns in these publications have reflected not only the intellectual input of individual researchers but also the dynamics of collaboration and the institutional factors that shape productivity. The understanding of the trend of authorship in the publication of computer science research from Nigerian universities is particularly necessary for identifying the trends of academic collaboration, institutional support for research, and the consequential impact of such publications in the global academic community. Authorship patterns refer to the order of authorship, the frequency of co-authorship, and the degree of collaboration between the researchers, which are all critical indicators of scholarly productivity and research quality. In computer science, as in many other fields, high-impact research outputs are often realized through collaborations. However, the collaborative nature of authorship can also introduce challenges related to authorship ethics, academic credit, and research visibility (Abdullahi et al., 2022). The study of authorship patterns in computer science publications can provide insight into the level of interdisciplinary collaboration, institutional support, and the broader academic culture within Nigerian universities.

Various studies have shown that research collaboration is higher in well-funded and globally connected institutions. Among computer science researchers in Nigeria, the pattern of authorship is influenced by various factors, including funding opportunities, the degree of technological infrastructure, and the intellectual environment within universities (Ojo & Akinmoladun, 2021). The academic output of Nigerian researchers in the field can be categorized either as collaborative or individual publications; collaborative works, in most cases, boast a retinue of authors from different institutions, which may even include international partners. This emphasizes the role that

networking and partnership play in the success of research works in Nigerian universities. The authors have also found that the pattern of authorship in Nigerian computer science publications reflects a high tendency toward collaborative publication, particularly in projects involving emerging areas of technology such as artificial intelligence, machine learning, and software engineering (Aliyu et al., 2020). These subfields of computer science do involve multiple disciplines; therefore, it is necessary for researchers at Nigerian universities to establish academic collaboration within and outside the country. Notwithstanding the increasing collaboration trend, issues such as disputes on authorship, disparities in the distribution of credits of authorship, and pressures regarding academic ranking prevail (Ogunyemi & Adebayo, 2019). There is also the growing concern about the gender dimension of authorship patterns in Nigerian university computer science research. Various studies have shown that, around the world, there exists a low representation of females in academic publications in relation to their male colleagues in the STEM fields, of which computer science forms a part (Aluko & Ajayi, 2021). Gender inequity in authorship means less visibility and recognition for women in academic circles. Efforts to bridge this gap have been ongoing, with policies and initiatives aimed at encouraging more female participation in research and ensuring equal representation in academic publications (Okpala & Eze, 2022).

In the face of these complications, a careful analysis of the patterns of authors in Nigerian computer science research publications is necessary. Such a study will provide a clearer understanding of how these patterns influence not only the academic careers of researchers but also the standing of Nigerian universities and the country's contribution to the global scientific community. This study hopes to explore the trends of authors of computer science publications in Nigerian universities, analyze factors that influence these trends, and make recommendations on ways to improve research productivity and collaboration in the field.

Problem Statement

The authorship patterns in computer science research within Nigerian universities are influenced by various factors, including collaboration dynamics, institutional support, and individual career goals. While collaborative research is growing, even in the fast-growing field of artificial intelligence and machine learning, little is known about how such patterns of collaboration affect the productivity and visibility of research. Research collaboration is essential for the advancement of computer science, but challenges like unequal authorship distribution, disputes over credit, and the influence of institutional factors remain persistent (Ogunyemi & Adebayo, 2019). This is further exacerbated by the absence of comprehensive data on the trends in authorship, making it really difficult for academic institutions and policies to make effective decisions to enhance research productivity and create equitable collaboration in Nigerian universities.

In addition to the challenges related to collaboration, gender disparities in authorship are a significant issue in Nigerian computer science research. Studies have highlighted that women are underrepresented in STEM research, with gender biases influencing the opportunities available to female researchers (Aluko & Ajayi, 2021). Lack of policies addressing the challenges facing female researchers in Nigerian universities has contributed to low visibility and publication rates by females compared to males. Such disparities in authorship patterns reflect broader structural inequalities within academia and require targeted interventions that guarantee fair representation and recognition for women in the field of computer science.

Besides, the role of institutional support in shaping the authorship patterns of computer science researchers in Nigerian universities remains underexplored. Most of the researchers face serious challenges in securing funds, accessing technological resources, and engaging in meaningful collaborations due to the limited infrastructure available at most Nigerian institutions (Ojo & Akinmoladun, 2021). These constraints impact not only the quantity of publications but also the quality of research outputs. Hence, this explains the need to comprehend how these institutional factors-funding and infrastructure-influence the trend in authorship patterns for designing proper

strategies that can increase Nigerian university research output and international collaboration in the field of computer science.

Research Objectives

The general objective of the research is to investigate into the authorship pattern in publication productivity of Computer Science Researchers in Nigerian Universities. The specific objectives are to:

1. know the kind of authorship pattern that exist in computer science research
2. determine the research capacity in computer science;
3. appraise the research capacity in computer science;

Literature Review

Authorship Patterns in Computer Science Research

In general, authorship patterns in computer science are affected by the complexity and collaboration involved in the discipline. With the increasing application of computer science to mathematics, engineering, and even business, many studies require several domains. This often leads to multiple authors on one paper. According to Okeke et al. (2020), collaborative authorship is a striking feature in computer science research; indeed, solving the complex problems that arise requires skills from a wide variety of quarters. This trend would more often than not happen in big projects, like in artificial intelligence, machine learning, and data analytics, wherein experts in these different fields should combine their efforts to come up with a solution.

The other important factor of authorship pattern relates to the order of authorship. For example, in certain fields, the first author usually is perceived to have provided the greatest contribution to the research. In computer science, though, especially in collaborative works, this may be less often so. Several studies have identified that this last author is often the senior, in charge of overseeing the research or providing the funding or advice (Gabbriellini et al., 2020). In Nigerian universities,

given the academic culture of mentorship, senior researchers and professors commonly appear last on these lists, guiding graduate students and junior researchers through the publication process.

Another feature of authorship in computer science research is the growing trend of international collaboration. As researchers in Nigerian universities face limitations in funding and infrastructure, they often seek partnerships with international colleagues to enhance their research capacity (Adeniyi et al., 2021). This global collaboration leads to an increase in multi-country, multi-author papers, where researchers from Nigeria often collaborate with experts from Europe, Asia, and North America. The collaborations are helpful in having an advantage over superior facilities: software, hardware, and sources of funds. On the downside, this global trend often leads to disparities in authorship, where local contributors may not get as much recognition as their international colleagues (Okeke et al., 2020).

Computer science research from Nigerian universities also tends to have a rather high number of authors. This is particularly the case for interdisciplinary research where the expertise of multiple authors is needed to address a given complex problem. According to Ogundipe and Durojaiye (2022), large research teams are common in emerging fields such as cloud computing, cybersecurity, and big data analytics, with publications often listing 5-10 authors. While this may reflect a productive and collaborative research environment, it also raises questions of authorship fairness, with contributions not clearly delineated and junior authors not being recognized for their work.

One of the striking features of computer science research authorship in Nigeria is the increasingly contributory role of graduate students and early-career researchers. These often make valuable contributions to the research, although they may not be listed as the first authors. Research by Adewumi et al. 2021 shows that graduate students often provide the drive for publication in Nigerian universities, with senior researchers often providing supervision and guidance. In return

for their immense contribution, many junior researchers often fail to get a first authorship that provides them with potentially life-long changing career prospects. This underlines the need to give better recognition in academic publications for early-career researchers.

Lastly, the issue of gender imbalance in authorship patterns persists as a key challenge in computer science research in Nigerian universities. Indeed, male researchers have been found, by Ibrahim and Adebayo (2022), to dominate the list of authors and, most specifically, the technical publications with high impact. This absence of women in prominent author roles is a continuous problem that results from cultural and institutional barriers restricting women's involvement in computing research. It is crucial that these discrepancies in gender be addressed to ensure fairness in recognizing the different contributors regardless of their gender status. Such inequalities could significantly be minimized by encouraging the female researcher to assume major roles in most publications.

Research Capacity in Computer Science

Infrastructure, funding, and human resources are some of the factors that affect research capacity in computer science at Nigerian universities. The advancement in technology resources such as high-performance computing systems, software tools, and databases is needed for research in computer science. Unfortunately, many universities in Nigeria face a high level of limitation in this regard, which could pose a challenge to developing high-end research (Adeniyi et al., 2021). Notwithstanding this, computer science researchers from Nigeria have shown resilience in conducting research, often depending on international collaborations to help get around infrastructural barriers that limit their research activities. However, the increasing availability of online resources and cloud-based technologies has also helped mitigate some of these challenges, though access to such technologies remains limited in many institutions today (Ogundipe & Durojaiye, 2022).

Another critical component that affects research capacity in Nigerian computer science is funding. While some universities have benefited from government and international grants, the overall availability of funding for research remains very low compared to global standards. The impact of this underfunding limits the potential for large-scale projects, attending international conferences, and collaboration that may help raise the visibility of researchers (Okeke et al., 2020). The institutional support is equally variable, as some universities invest in special research centers for computer science, while others lack the resources that may help spur research innovation. This uneven support structure affects the consistency and quality of research output across Nigerian universities, with more privileged institutions often achieving better results.

The research capacity in the computer science departments of Nigerian universities is influenced by the availability of skilled human resources. The quality of the research is highly dependent on the expertise and experience of the faculty members who handle the research. However, retention is problematic as many experienced researchers migrate to better-funded institutions or abroad seeking better opportunities (Adewumi et al., 2021). The additional challenge most Nigerian universities face is faculty shortages in specialized areas of computer science, particularly those that are emerging, like artificial intelligence and data science. This shortage of skilled personnel could mean limitations in the scope of research projects and competitiveness at the international level in advanced areas of computer science research.

Despite these challenges, various initiatives have seen Nigerian universities make strides to improve their research capacity in computer science. For instance, some have established relationships with international universities that avail their researchers with access to global resources and networks. According to Adeniyi et al. (2021), such collaboration will not only improve the quality of research output but also expose students and faculty to international best practices in research methodologies. Additionally, the growing number of graduate students pursuing computer science-related degrees is an encouraging sign of the increasing human

resource capacity, with many of these students contributing significantly to the research output in the field (Ogundipe & Durojaiye, 2022).

While Nigerian universities face significant challenges to build research capacity in computer science, a variety of avenues are available for improvements that could be made. The overall research output will likely improve with increased investment in infrastructure, securing more research funding, and enhancement of faculty development programs. Furthermore, developing stronger international collaborations and supporting graduate students in their research will enhance the growth of computer science research in Nigeria. Addressing these gaps will place Nigerian universities in a better position to be more competitive within the global academic community for continued contribution into innovations in computer science.

Appraisal of Research Capacity in Computer Science

While the capacity for computer science research in Nigerian universities is promising, it remains limited by a number of challenges that affect both the quality and quantity of the academic output. Among the main barriers is a lack of adequate infrastructure, which hinders the conduct of high-level research. Most of the institutions in Nigeria lack well-equipped modern laboratories, high-performance computing resources, and state-of-the-art software tools that can easily facilitate advanced research in areas such as artificial intelligence, machine learning, and data science. As Adeniyi et al. (2021) have asserted, this is often the reason why researchers have to use external collaborations or less sophisticated resources, thus limiting the depth and breadth of their work. The increase in cloud computing and free online resources has brought partial relief, despite all odds, to enable researchers to overcome infrastructure deficits to a partial extent.

Another very critical issue that directly affects the research capacity in Nigerian computer science departments is funding, or rather, the lack of funding. Whereas a few universities have received some sort of government funding and international grants, the allocations remain quite limited to

sustain long-term high-impact research projects. According to Okeke et al. (2020), this funding constraint leads to a reduction in the number of opportunities available to researchers to attend international conferences, participate in collaborative projects, or access essential research materials. It would also mean a reduction in the number of graduate students that can be supported and limits their contribution to big teams, too. Obviously, increasing research funding can go a long way toward giving Nigerian universities a presence competitive in world leadership in computer science.

Human resource capacity also plays a pivotal role in shaping the research landscape in Nigerian computer science. The quality of research largely depends on the expertise of the faculty and researchers. However, Nigerian universities face a significant challenge in retaining skilled faculty members, as many migrate to better-funded institutions or abroad for more attractive research opportunities (Adewumi et al., 2021). This brain drain undermines the ability of local institutions to build sustained research capacity. Additionally, there is a shortage of experts in specialized fields of computer science, particularly in emerging technologies like cybersecurity and blockchain. Although the number of graduate students entering the field is on the rise, the limiting factor in enhancing the overall research output in computer science is the lack of skilled mentors and faculty to guide them.

Despite these, Nigerian universities have made reasonable efforts toward increasing their research capacity through international collaboration, students' research engagement, and faculty development. Collaboration with international institutions has expanded resource availability and thus has engaged researchers in collaborative projects that build their capacities to raise the output and visibility of research. As Ogundipe and Durojaiye (2022) observe, these international collaborations open the avenue for Nigerian researchers to tap into global networks, share knowledge, and be exposed to advanced research methods. Secondly, the increasing number of graduate students in computer science is an encouraging future indicator of research capacity, as

many of the students are active in academic publications. With further investment in infrastructure, funding, and human resources, Nigerian universities are in a position to further develop their research capacity and establish themselves as major players in global computer science research.

Methodology

The bibliometric research design was adopted for the study. The population for the study consists of the publications of computer scientists in federal universities in Nigeria between 2005 and 2015. Data was retrieved from Google scholar database. The researcher has collected the list of computer science researchers from 26 federal universities in Nigeria and yet to receive from 10 federal universities in Nigeria. Complete enumeration of the publications of computer researchers in federal universities in Nigeria between 2005 and 2014.Data stored and managed in my Google Library was exported to Microsoft Excel for analysis. Descriptive statistics such as frequency counts, percentages and cumulative frequencies was used to analyse the research questions and the null hypotheses raised in this study. Lokta's formula was used to test the pattern of productivity, Kolmogorov-Simonovtest was used to check for the goodness of fit of that pattern.

Results and Discussions

Table 1: Authorship pattern in computer science research 2005 – 2014

From the table below, it is evident that the authorship pattern in the field of Computer Science within the period understudy in Google scholar database is majorly collaborative.

S/N	Pattern Of Authorship	No. Of Pub.	% No. Of Pub.	No. Of Authorship	%No. Of Authorship
1	One author	72		72	
2	Two authors	294		588	
3	Three authors	292		876	
4	Four authors	68		272	
5	Five authors	16		80	

	742	1880

The authorship pattern in computer science research from 2005 to 2014, as shown in the table, highlights a strong trend towards collaborative work. While there are instances of single-author publications, accounting for 72 publications (9.7% of the total publications), this constitutes a relatively small portion of the overall body of research. The number of publications with more than one author outpaces single-author work by a wide margin, suggesting that computer science research during this period was predominantly a collective endeavor. The fact that over 90% of the publications involved two or more authors reflects the increasing complexity of research, where multidisciplinary collaboration and shared expertise are often essential.

The largest proportion of publications comes from works with two authors: 294 publications, or 39.6%, while three-author publications take the lead with 292 or 39.4%. That will mean that most research in computer science during the period studied was done in small teams, probably specialists working on focused problems. Such collaborations might allow for efficient sharing of responsibilities, diverse perspectives, and the ability to tackle complex problems more effectively. The strong presence of two- and three-author works shows that small research teams were the most characteristic model in this period, which can be explained by the necessity of knowledge from several sub-domains within computer science.

Larger teams also took part in computer science research, though to a lesser degree. Publications with four authors counted 68 or 9.1%, and publications with five authors totaled 16 or 2.2%; both of these constitute meaningful proportions of the overall research. This may reflect the growing trend toward larger, more interdisciplinary research teams, especially in fields like artificial intelligence, data science, and machine learning, where the complexity of the problems often requires a diverse range of skills. Yet, even with larger teams being present, the majority of the

publications were from smaller teams, hence cementing the perception that smaller collaborations were indeed the dominant mode of authorship in this field for the 2005-2014 period.

Table 2: Frequency distribution of publication productivity of computer science research 2005 -2014

No. of publications	No of authors	Cum. of authors	Cum. Of publications	Percentage of publications
2	1	1	2	0.27
1	1	2	3	0.13
0	1	3	3	0
2	1	4	5	0.27
4	1	5	9	0.54
6	1	6	15	0.81
18	1	7	33	2.43
13	1	8	46	1.75
10	1	9	56	1.35
16(72)	1(10)	10	72	2.16
16	2	12	88	2.16
3	2	14	91	0.40
9	2	16	100	1.21
20	2	18	120	2.70
14	2	20	134	1.89
21	2	22	155	2.83
39	2	24	194	5.26

38	2	26	232	5.12
53	2	28	285	7.14
81(294)	2(20)	30	366	10.91
13	3	33	379	1.75
16	3	36	395	2.16
17	3	39	412	2.29
9	3	42	421	1.21
22	3	45	443	2.96
34	3	48	477	4.58
46	3	51	523	6.19
36	3	54	559	4.85
36	3	57	595	4.85
63(292)	3(30)	60	658	8.49
0	4	64	658	0
6	4	68	664	0.81
7	4	72	671	0.94
3	4	76	674	0.40
4	4	80	678	0.54
3	4	84	681	0.40
17	4	88	698	2.29
5	4	92	703	0.67
13	4	96	716	1.75
10(68)	4(40)	100	726	1.35
0	5	105	726	0

1	5	110	727	0.13
1	5	115	728	0.13
1	5	120	729	0.13
1	5	125	730	0.13
1	5	130	731	0.13
2	5	135	733	0.27
2	5	140	735	0.27
4	5	145	739	0.54
3(16)	5(50)	150	742	0.40

The frequency distribution of publication productivity in computer science research from 2005 to 2014, as illustrated in this table, provides valuable information regarding the amount of research output and the dispersion of authorship. It follows that most of the publications emanate from a few authors, while a few publications are highly productive. For instance, publication productivity of 30 publications accounts for 10.91% of all publications, meaning that only a few highly productive authors contributed to the overall research output. Publications with a low number of authors, like 2 or 3 publications, are also rather frequent, though they constitute a small fraction of the total publications.

The table indicates that for most authors, the number of publications ranges from 1 to 5 throughout the study period. Publications that have only one author are scattered in the frequency distribution, with a few anchoring concentrations, such as this category with 16 publications that appears quite frequently. That could mean a certain consistency from individual authors who may not have published much but at least remained active in producing research. The frequency of authors with low numbers of publications is significantly higher, reinforcing the idea that many researchers in

computer science publish occasionally, but fewer produce significant numbers of publications each year.

The data also shows that the higher the number of authors, the lower the number of publications. For example, although a high proportion of research articles involved two or three authors, larger teams, such as those with four or five authors, were less frequent. For instance, the category with five authors represents a very low frequency: just a few entries for all authors who have from 5 to 10 publications. The productivity in these larger teams is less concentrated compared with the more consistent output coming from smaller groups, and it points to the fact that the research projects pursued by larger groups may be more specialized, hence generally resulting in fewer published outputs.

Another striking feature of this distribution is the strong output concentration in specific productivity ranges of the authors, especially with two and three authors. Publications with 2 or 3 authors are great in number, as depicted by rows showing 81 publications with 2 authors contributing almost to 11% of total publications. Correspondingly, the category of three authors also shows a very high contribution, with 292 publications recorded in the table. It seems from here that the most frequent collaboration sizes in computer science research are small, while the increase in the number of authors generally leads to a decrease in the frequency of publications. These trends reinforce the notion that collaboration, particularly among small teams, is essential in computer science research, though larger teams tend to be less common in practice.

Summary of Findings

1. **Prevalence of Small Team Collaborations**: It also emerges from the study that, for the period spanning 2005 to 2014, most of the computer science research publications were produced by small teams, especially those with two or three authors. For the period under consideration, 39.6% were publications with two authors, while 39.4% were with three authors. This shows that a small

number of collaborating researchers were dominant in the field of computer science during this period.

2. Lower Frequency of Larger Teams: The larger the team of authors, the fewer the publications. Larger teams of four or more authors were relatively rare. For instance, four-author publications only made up 9.1% of the total output, while five-author publications were even more infrequent, at 2.2%. This therefore gives an indication that while large teams do exist, most research is conducted by small, focused groups.

3. Highly Productive Authors Drive Publication Output: It can also be realized that only a small percentage of highly productive authors make big contributions to the total output. For example, there were a fair number of authors with 20 to 30 publications that contributed to a reasonable percentage of the total output, such as the "30 publications" group with 10.91% of the total output. It illustrates that prolific researchers play a vital role in every field, with just a few researchers contributing a considerable portion of the research.

Conclusion

The analysis of the authorship patterns in computer science research in Nigerian universities reveals several remarkable trends that shape the academic landscape in the field. The defining feature of collaboration is that most of the publications were produced by small teams of two or three authors. This may reflect the rising complexity of research problems in computer science, which often require diverse expertise and multidisciplinary approaches. While larger teams are less common, they are extremely important for addressing emerging areas such as artificial intelligence and machine learning. In general, the co-authorship pattern indicates how important

partnership, both within and outside the country, continues to be in driving research output and impact.

The paper focuses on collaboration, yet still, it points out that this may be problematic to equally share academic credit and authorship. Specific issues that have to do with unequal recognition of junior researchers, gender disparities, and institutional support persist. Underrepresentation of female researchers in authorship, particularly in leading positions, raises serious concerns about inclusivity and diversity in computer science research. The uneven availability of infrastructure and funding across universities in Nigeria further constrains the capacity for high-quality research, making international collaborations a necessary yet often unequal way for researchers to surmount such constraints.

These challenges need to be addressed through targeted initiatives in order to foster a more robust and inclusive research environment. The enhancement of institutional support, investment in technological infrastructure, and policies that ensure just authorship practices are of paramount importance. Encouragement of female participation and mentorship opportunities for early-career researchers will go a long way in balancing the academic landscape. By leveraging these strategies, Nigerian universities can strengthen their contributions to global computer science research, cultivating a more equitable and innovative academic community.

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