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Scientific Collaboration and Research Productivity: Evidence from One College in Makerere University

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In academia, the many benefits of publishing make continuous publication a cardinal duty of faculty members. Some members work as lone writers and others work collaboratively to come up with scholarly works. Benefits of collaboration come in form of filling gaps between the haves and the have not by academic staff. In this study, the aim was to establish whether research collaboration among academic staff was related to research productivity. More specifically, we examined whether collaboration in publication of edited books, chapters in edited books, journal articles, and conference papers by members of academic staff was related to their research productivity. Using collaboration and publication data on 41 academic staff members in the College of Education and External Studies, Makerere University, we analysed the relationship between the two. Results of the Karl Pearson's linear correlation coefficient indicated that the academic staff who collaborated were more research productive. This was true for all the four forms, individually namely; edited books, chapters in edited books, journal articles, and conference papers and in terms of aggregated four forms. This study underscores the importance of cultivating collaborative environments in academia to bolster scholarly output, which is not only to the benefit of academic staff but also to university administrators and policymakers when endorsing collaborative research initiatives and interdisciplinary cooperation. Thus, it contributes to the theoretical understanding of the subject by furnishing empirical evidence on the relationship between scientific collaboration and RP by members of academic staff.

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INTRODUCTION

The higher education environment has undergone a significant global transition from a teaching-centric to a research-centric one. This transformative shift traces its origins to the 19th century Humboldtian model, which laid the foundation for research productivity in universities, for them to emerge as centres of knowledge creation across diverse disciplines (Altbach, 2011). Lecturers are therefore pursuing research either individually or through collaborative effort. Webber (2011) defined research productivity as "the number of publications produced in a short period of time (such as one or two years) or a lifetime career" (p. 109). Academic staff ought to publish throughout their careers to remain relevant. This research is not only for promotion of lecturers but also for generation of knowledge for use by policymakers, corporate sector, and society at large (Kaweesi et al. 2019). Scholars have investigated the subject of research productivity since the 1970s (Abramo et al., 2009). Realising high research productivity, however, has not come easily to academic staff members who work as *lone writers*. Hence, they are now co-publishing.

Araujo et al. (2014) defined a collaboration as "a research which results in a co-authored scientific paper" (p. 1). Jameel and Ahmad (2020) defined collaboration as "a close association of two or more researchers with one or more common objectives in a research project" (p. 112). Ynalvez and Shrum (2010) conceptualised collaboration as a close interaction between two or more scientists in a research project. Whereas some scholars (e.g., Friedman & Sills, 2015; Ponomariov & Boardman, 2010; Vuong et al., 2017) have referred to scientific collaboration as research collaboration, others (e.g., Albert et al., 2016; Gopaul, et al., 2016; Horta & Santos, 2016) have called it co-authorship. Scientific collaboration has benefits which relate to filling gaps like; competency gaps, idea gaps, time gaps,

equipment gaps, and other resource gaps (Abramo et al., 2017). Researchers, thus, join effort and complement their existing inequities to come up with sound scholarly works.

According to Iglic et al. (2017), scientific collaboration can either be domestic or international. In domestic collaboration, collaborating researchers may either belong to the same institution or they may be affiliated to different institutions. Iglic et al. (2017) referred to these as intra-institutional and inter-institutional collaborations respectively. In an international collaboration, on the other hand, collaborating authors belong to universities in different countries. Scientific collaboration can also be transdisciplinary where the issue of concern to collaborating scientists goes beyond the boundaries of one discipline (Kaweesi, 2018).

By examining the data on research collaborations and productivity among academic staff in a college in Makerere University, the study uncovers the underlying mechanisms shaping research productivity. More specifically, in this study, we investigated whether research productivity was related to collaborations among academic staff. Given the diversity of findings in existing literature, the study contributes to the existing body of knowledge by investigating specific forms of collaboration and their impact on the RP of academic staff members in the College of Education and External Studies (CEES) at Makerere University. In examination of the relationship between the various dimensions of research collaboration and research productivity (RP), the objectives were to:

- Examine the correlation between scientific collaboration in book publications among academic staff and their research productivity.
- Examine the correlation between scientific collaboration in book chapter publications

among academic staff and their research productivity.

- Examine the correlation between scientific collaboration in journal article publications among academic staff and their research productivity.
- Examine the correlation between scientific collaboration in conference paper publications among academic staff and their research productivity.
- Examine the correlation between scientific collaboration in all research publication forms among academic staff and their research productivity.

RELATED LITERATURE

Scholars have investigated the subject of research collaboration from a number of perspectives. Some (e.g., Gorjizadeh & Eftekhar, 2016; Kaweesi et al., 2018; Keck et al., 2017) have examined it as an outcome variable influenced by various factors. Gorjizadeh and Eftekhar (2016) measured institutional collaboration, the quality of journals, and the role of highly productive authors in highly cited articles by Iranian researchers. Overall, they analysed 899 publications in management and operations, 432 publications in economics and business. They, hence, found intra-institutional collaboration to be greater than inter-institutional collaboration. In a study conducted in Uganda, specifically in Makerere University, Kaweesi et al. (2018) explored the disciplinary practices, values, and beliefs that informed the research choices of lecturers in different disciplinary fields. Using a case study design, they collected data from 12 professors through interviews. They also collected some data using document review where they reviewed strategic plans, annual reports, and research policies. Their thematic analysis revealed that research choices of lecturers were informed by a collaborative culture where the development partners and donors who fund them espouse this.

Keck et al. (2017) sought to establish whether research productivity, impact, and collaboration

among doctoral students trained in trans-disciplinary science early in their career development differed from that of their peers trained in traditional doctoral programs. Using independent samples t-test, they found out that works published by trans-disciplinary students had more cross-disciplinary collaborations compared to those of doctoral students in traditional programs. Kumar and Ratnavelu (2016) investigated how research collaboration changed with age, gender, marital status, institution type, professional experience, and qualification of economists. Using a chi-square test, they found significant differences in collaboration only when it came to age, gender, and number of years an economist had spent in their present institution. Li et al. (2015) studied how the alumni linkage, the connection between alumni faculty members, and their *alma mater*, influenced the individual collaborative behaviour of returnee scholars. They used bibliometric data for 112 returnee scholars in China which they obtained from Web of Science. Using regression, they found out that alumni faculty conducted less intra-institutional collaboration than non-alumni faculty, and the impact of alumni linkage on a scholar's propensity towards international collaboration was not significant.

Other scholarly investigations within higher education have been on the relationship between research collaboration and research productivity among academic staff. Some (e.g., Allen et al., 2018; Parish et al., 2018; Vuong et al., 2019) found a positive correlation between collaboration and RP, while others (e.g., Abramo et al., 2017; Lee & Bozeman, 2005; Ynalvez & Shrum, 2010) have found contrasting results, reflecting the complexity of this relationship. Allen et al. (2018) explored the scholarship experiences of top ranked African American academic staff in schools of social work. The experiences related to the challenges that barred members from being research productive, and then, how they overcame these challenges. They interviewed ten participants and analysed data using a thematic analysis. Their data analysis generated four themes of scholarship experiences: mentorship,

collaboration, time, and strategic planning. Of these themes, mentorship was the most important while collaboration was the least important. However, Allen et al. (2018) regretted using a small sample in their study, whose experiences could not necessarily hold for all other social work lecturers. Secondly, they regretted selecting their sample basing on the h-indices of lecturers, which has its challenges. The challenges include possibilities of self-citation so as to inflate the citation count, difficulties in apportioning credit to the authors in case of a co-authored article, and then its inapplicability in fields other than the clinical related (Kasabwala et al., 2014; Huang et al., 2015).

Ductor (2015) investigated the causal effect of scholarly collaboration on research output. They examined a panel of data on economists who had published from 1970 to 2011. Using regression, they found out that co-authorship led to higher individual research productivity even though the effect varied significantly between the more and less productive researchers. He et al. (2009) investigated the relationship between research collaboration among academic staff and their subsequent research productivity. They used publication data for 65 biomedical scientists from New Zealand which they obtained from the Web of Science. Using regression analysis, they found out that collaboration among academic staff members increased their research productivity. However, He et al. (2009) regretted using a small sample and concentrating on collaborations between either government research institutions or private enterprises and the academic staff members other than those between the academic staff and fellow academic staff.

Hedjazi and Behravan (2011) sought the relationship between three categories of factors: individual, institutional, and demographic, with research productivity of academic staff members in Iran. They obtained some data from the personal files of academic staff members and then the other data using questionnaires. Using regression analysis, regarding institutional factors, they found network of communication

with colleagues to be among the significant predictors for research productivity of agricultural lecturers they studied. Kyvik and Reymert (2017) examined the role of research networks in stimulating research productivity among professors and associate professors in four major research universities in Norway. They found out that professors who belonged to research groups realised higher research productivity than those who never belonged to such groups. Kyvik and Reymert (2017) however regretted studying professors with a limited number of research colleagues in the same research specialty.

In another study, Parish et al. (2018) investigated the correlates of collaborative behaviour and whether such behaviour impacted scientific impact. They extracted data on members of academic staff in 11 fields from the Scopus database for the period 2006 through 2015. Using the analysis of variance, they found collaboration to be associated with higher citation impact with the effect being different according to fields. Parish et al. (2018) however regretted only studying authors whose total publication count was greater than or equal to 30, hence, making their findings inapplicable to less productive researchers. In addition, Parish and their colleagues only used the h-index as a measure of citation impact which measure has some challenges. Vuong et al. (2017) analysed the impact of collaboration on the research productivity of social scientists from Vietnam. They used a dataset prepared by Vuong and Associates on publications by 406 academic staff for the period that ran from 2008 up to 2017. They corroborated these data with what existed on personal websites, institutional websites, journal websites, Google Scholar, and Scopus. Using regression analysis, they found out that research collaboration increased the research productivity - the effect being higher in domestic collaborations than in foreign collaborations. Vuong et al. (2017) however regretted using a small sample size and crediting each author in a co-authored paper depending on their position in the by-line, which could have been somehow inappropriate. Vuong et al. (2019) investigated the effect of work

environment and collaboration on research productivity of social scientists in Vietnam. They used publication data for social scientists for the period from 2008 up to 2017 which they obtained from Scopus. Using ordinary least squares, they found out that international collaborations boosted research output of the social scientists. The effect of collaboration on research productivity was however insignificant among high performing authors.

For other scholars, the impact of research collaboration on research productivity among academic staff members was not significant. Abramo et al. (2017) sought to establish the relationship between collaboration types and research productivity. They studied professors in fields of science and economics in Italy for three years. Using structural equation modelling, they found out that intramural and domestic collaboration led to significant increase in research productivity while international collaboration had a negative but non-significant relationship with research productivity. Lee and Bozeman (2005) investigated the extent to which collaborations affected the research productivity of scientists. They extracted publication data of each lecturer from the Science Citation Index Expanded. They counted peer-reviewed journal articles that each scientist published from 2001 up to 2003. They used both the normal count and fractional count when establishing research productivity. Using what they termed as two-stage least squares test (p. 677), regarding normal count, Lee and Bozeman (2005) found scientific collaboration to be a strong predictor of research productivity, but when it came to the fractional count, the relationship between scientific collaboration and research productivity was not significant. Ynalvez and Shrum (2010) investigated whether scientific collaboration increased research productivity among agricultural scientists in national research institutes and state universities in two locations in the Philippine. Using regression, they found out that scientific collaboration did not increase publication productivity.

However, this literature review reveals contextual intricacies, pertinent limitations and specific gaps, thus, underscoring the need for further targeted research to deepen the understanding of the scientific collaboration-research productivity nexus. Addressing this necessitated use of a more appropriate measure of research productivity, study of academic staff belonging to both science and humanities fields and in a university in Uganda – a developing country. Therefore, basing on the study objectives, considering the various perspectives of research productivity, we tested the following hypotheses:

H₁: Scientific collaboration in book publications among academic staff positively correlates with their research productivity.

H₂: Scientific collaboration in book chapter publications among academic staff positively correlate with their research productivity.

H₃: Scientific collaboration in journal article publications among academic staff positively correlate with their research productivity.

H₄: Scientific collaboration in conference paper publications among academic staff positively correlate with their research productivity.

H₅: Scientific collaboration in all research productivity forms among academic staff positively correlate with their research productivity.

METHODOLOGY

In this study, the document review was the approach for obtaining data on academic staff within the College of Education and External Studies at Makerere University, their publications, and scientific collaborations. The initial step involved compiling a list of academic staff employed in the college. This was followed by selecting members who were on full-time basis, and who had obtained qualifications of PhD not later than 2011. Obtaining of the year of qualification with a PhD for each member from their curriculum vitae (CV) on the college website then ensued. These members were supposed to have been employed in Makerere University by

2011 for them to create meaningful synergies for scholarship and collaborations. The total members of academic staff that qualified were 41. Subsequently, the data of interest for each academic staff was on their publications from 2013 up to 2016, encompassing various forms namely edited books, chapters in edited books, journal articles, and conference papers. Primary data sources included Makerere University annual reports, supplemented by cross-checking with publications by academic staff members on the college website, and the curriculum vitae (CVs) of these staff members.

To ensure consistency and comparability across different publication types for each academic staff, we assigned respective counts for each publication to the contributing academic staff. This scoring system, adapted from Lee and Bozeman (2005), facilitated the evaluation of research productivity while accounting for variations in authorship patterns. According to Lee and Bozeman (2005), for multi-authored publications, three kinds of counting exist namely, *straight count*, *fractional count*, and *normal count*. In the *straight count*, only the first author receives credit, in *fractional count*, the credit of the publication is shared amongst the number of co-authors, and in *normal count*, full credit goes to all contributors of the publication. A fractional count method for multi-authored publications was appropriate, while for sole-authored publications, a normal count method was appropriate.

Assessment of the overall research productivity for each academic staff, involved aggregating publication counts across the four forms of publications. We apportioned scores of five, three, two, and one for each edited book, journal article, chapter in an edited book, and conference paper respectively. Additionally, a collaboration score was calculated to quantify the extent of research collaboration engaged in by each staff member over the specified four-year period. This collaboration score provided valuable insights into collaborative dynamics within the academic community, complementing the analysis of individual research productivity. Finally,

correlational analysis between research collaboration and productivity using Karl Pearson's linear correlation coefficient ensued. The analysis was on the relationship between research collaboration and productivity across different publication types, providing a nuanced understanding of collaborative dynamics within the academic setting. This correlation analysis helped to uncover potential associations that could inform future research collaborations and practices among academic staff members.

RESULTS

To establish how the 41 academic staff members collaborated in their research, it required establishing the number of co-authors that each member authored with a given publication. Regarding books, out of the 41 members, only two had participated in authoring books in the four years under review. One lecturer had participated in authoring two books while the other one participated in authoring one book. One who had authored two books collaborated with two co-authors while one who never collaborated authored one book. For book chapters, 13 members had participated in authoring them in the four years. Of these members, three had solely authored the book chapters while ten collaborated. Altogether, on average, the 13 members collaborated with four co-authors but the highest number of collaborators a lecturer had was seven. Regarding collaboration for a single book chapter, the highest number of authors was five while the lowest number was three.

For journal articles, 30 academic staff participated in their authorship during the four years under review. These members collaborated with others to produce the journal articles. An author with the highest number of journal articles had 22 journal articles while one with the lowest number had one article. The highest number of collaborators a lecturer had overall was 28 and the lowest number was one. Regarding collaboration for a single journal article, seven authors had authored a number of journal articles as the maximum number of authors. Concerning conference papers, of the 41 members, ten had participated in

authoring conference papers. Nine of these collaborated with others as one member did not. The academic staff member with the highest overall number of collaborations collaborated with 22 colleagues in authoring 34 conference papers. On average, each lecturer collaborated with four colleagues. The highest number of authors of a conference paper was five while the lowest number was three.

We then aggregated the number of collaborators for each lecturer from the four forms of publications. The lecturer with the highest overall number of collaborators had 33 collaborators, while those with the least number of collaborators had only one collaborator. Inferential results of the Karl Pearson's linear correlation coefficient (PLCC) test as to whether research collaboration among academic staff members impacted their research productivity were as in *Table 1*.

Table 1: PLCC test results on total collaborations in publication of books, book chapters, journal articles, conference papers, individually and aggregately on research productivity

Construct	1	2	3	4	5	6
1. Research Productivity	1					
2. Books	0.319* 0.042	1				
3. Book Chapters	0.564** 0.000	-0.073 0.649	1			
4. Journal Articles	0.748** 0.000	0.251 0.114	0.575** 0.000	1		
5. Conference Papers	0.745** 0.000	0.028 0.860	0.262 0.098	0.157 0.326	1	
6. Total Collaborations	0.978** 0.000	0.189 0.237	0.679** 0.000	0.794** 0.000	0.705** 0.000	1

Note. * Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed); PLCC Represents Karl Pearson's linear correlation coefficient.

Results of the Karl Pearson's linear correlation coefficient (PLCC) test (*Table 1*) revealed that there was a statistically significant relationship between collaboration in book publication and research productivity ($r = 0.319$; $p = 0.042 < 0.05$). Hence, the first hypothesis H_1 to the effect that scientific collaboration in book publications among academic staff positively correlates with their research productivity was supported. When it came to the relationship between collaboration in book chapter publications and research productivity of academic staff, results of the PLCC test (*Table 1*) revealed that it was statistically significant ($r = 0.564$; $p = 0.000 < 0.01$). Hence the second hypothesis H_2 to the effect that, scientific collaboration in book chapter publications among academic staff positively correlates with their research productivity was supported.

With respect to publication and collaboration in journal articles, results of the PLCC test (*Table 1*)

revealed that there was a statistically significant relationship between collaboration in publication of journal articles and research productivity ($r = 0.748$; $p = 0.000 < 0.01$). Therefore, the third hypothesis H_3 to the effect that, scientific collaboration in journal article publications among academic staff positively correlates with their research productivity was supported. Regarding the relationship between collaboration in publication of conference papers and research productivity of academic staff, results of the PLCC test (*Table 1*) revealed that it was statistically significant ($r = 0.745$; $p = 0.000 < 0.01$). Thus, the fourth hypothesis H_4 to the effect that, scientific collaboration in conference paper publications among academic staff positively correlates with their research productivity was supported.

After aggregating the counts of four forms of publications and the number of collaborators for each lecturer from the four forms of scholarly

works, we obtained a more defined picture of the influence of research collaboration on research productivity of academic staff members. Results of the PLCC test (*Table 1*) revealed that there was a statistically significant relationship between collaboration and research productivity ($r = 0.978$; $p = 0.000 < 0.01$). Therefore, the fifth hypothesis H_5 to the effect that, scientific collaboration in all research productivity forms among academic staff positively correlates with their research productivity was supported.

DISCUSSION

The findings of this study provide insights into the relationship between collaboration in various forms of publications and research productivity among academic staff members. Results indicated that generally, academic staff members who collaborated more were also more research productive where the topmost collaborators were also among the top most research productive. The result in the current study was congruent to those of previous scholars (He et al., 2009; Hedjazi & Behravan, 2011; Kyvik & Reymert, 2017; Parish et al., 2018; Vuong et al., 2017) who found out that research productivity was high among academic staff members who collaborated most. Such congruence might be related to a number of reasons for example, obtaining publication data from one data source. As the publication data for academic staff in the current study was obtained from the Makerere University annual reports, even some past scholars obtained the research productivity data for members of academic staff from some specific databases. These sources were Web of Science (He et al., 2009), Scopus (Parish et al., 2018). Some scholars, however, unlike in the current study, used more than one data source. Hedjazi and Behravan (2011) made the academic staff to fill questionnaires and also got some data from the personal profiles of lecturers. Vuong et al. (2017) used data from personal websites, institutional websites, journal websites, Google Scholar, and Scopus.

Other congruency were in terms of attributes of academic staff members in the current study as compared to those in the previous studies.

Whereas the current study only involved academic staff holding PhD qualifications, even Kyvik and Reymert (2017) studied professors and associate professors. Then, just like the members of academic staff in the current study belonged to only one college in Makerere University, even He et al. (2009) only looked at biomedical scientists, as Vuong et al. (2017) only studied social scientists. Consideration of one group of researchers would have been responsible for the homogeneity in findings as the effect of the existent factors that are at play in a similar group could not have been too variant.

For some of these studies, however, in spite of some methodological differences compared to the current study, their findings were surprisingly similar to those in the current study, as an increase in research collaboration was associated with increased research productivity. A case in point is four-year research productivity period in the current study that ran from 2013 up to 2016 which was different from most of that used by previous scholars. Some (Parish et al., 2018; Vuong et al., 2017) considered a ten-year period. That for Parish and colleagues ran from 2006 through 2015, and that for Vuong and colleagues ran from 2008 through 2017. The applicability of the four-year period needed to be handled with caution. This period was likely to be at the benefit of members of academic staff who had served for longer periods and, hence, identified potential co-authors to work with in the four years. For the other members that had just started their career, this might not have been possible.

Further, the study by Kyvik and Reymert (2017) was on academic staff members in four major research universities which was at variance with the current one that was only in one university. The existing conditions in one university might be totally different, not to favour effective collaboration either of an internal nature or of an external nature. Finally, there existed differences between the sample sizes used in the previous studies and that of the current study. The largest sample size was made up of 1,481 members of academic staff studied by Kyvik and Reymert

(2017), the ten studied by Allen et al. (2018), and then five that Vuong et al. (2017) studied. Expanding the sample scope either through using a very large sample size or drawing these from many fields could have caused the variance in results due to personal and environmental differences.

CONCLUSION

We sought to establish the relationship between research collaboration and research productivity of academic staff. After analysing data on 41 academic staff in a college in Makerere University, results indicated that collaborative efforts across different publication types significantly enhanced research productivity. We, thus, concluded that research collaboration was statistically significantly linearly positively correlated with research productivity of a member of academic staff. The study findings have practical implications for academic administrators and policymakers, highlighting the value of supporting collaborative research initiatives and interdisciplinary collaboration. Furthermore, they contribute to theoretical understanding by providing empirical evidence of the relationship between collaboration and research productivity, further emphasizing the significance of collaborative endeavours in academic research. The study, however, had a number of limitations which we have highlighted. To begin with, collaborations and research productivity of academic staff members was not for their entire career. This was in a bid of catering for longevity differences of academic staff members in the academia. Secondly, some forms of publications by some authors did not clearly record their publications for them to be identified as to whether they were edited books, book chapters in edited books or even journal articles. In some instances, publications by members of academic staff appeared both as conference papers and then journal articles in consecutive years. In addition, some conference papers were read by their authors in more than one conference, thus, breeding the ground for double counting. Finally, some academic staff varied the order of their names in

different publications. We, however, solved some of these by ignoring conference papers which were developed into journal articles, ignoring publications which were still *in press*, and considering names given on the CVs of academic staff members. Never-the-less, we strongly recommend that universities put in place measures for academic staff members to continue co-publishing so that they can harness its benefits and ultimately improve their research productivity.

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