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Do discounted journal access programs help researchers in sub-Saharan Africa? A bibliometric analysis

Philip M. Davis, Research Associate, Department of Communication, Cornell University, Ithaca, NY 14853 (pmd8@cornell.edu)

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Abstract

Prior research has suggested that providing free and discounted access to the scientific literature to researchers in low-income countries increases article production and citation. Using traditional bibliometric indicators for institutions in sub-Saharan Africa, we analyze whether institutional access to TEEAL (a digital collection of journal articles in agriculture and allied subjects) increases: 1) article production; 2) reference length; and 3) number of citations to journals included in the TEEAL collection. Our analysis is based on nearly 20,000 articles—containing half a million references—published between 1988 and 2009 at 70 institutions in 11 African countries. We report that access to TEEAL does not appear to result in higher article production, although it does lead to longer reference lists (an additional 2.6 references per paper) and a greater frequency of citations to TEEAL journals (an additional 0.4 references per paper), compared to non-subscribing institutions. We discuss how traditional bibliometric indicators may not provide a full picture of the effectiveness of free and discounted literature programs.

Keywords: sub-Saharan Africa, libraries, information transfer, citation analysis

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Introduction

With the exception of major economic and political events, global production of scientific knowledge has been increasing incrementally and predictably over time (1-4). Since the 1970s, however, scientific output in sub-Saharan Africa has not kept pace with global trends (5-8), the result of low investment in research and development, poor infrastructure to support science, technology and higher education, and a situation exacerbated by socio-political, economic, environmental and health issues (9, 10). During the 1980s and 1990s, public spending on research and development in sub-Saharan Africa stagnated, and in many countries, even contracted (11). While spending in R&D began to grow again during the 2000's, the bulk of new investment was concentrated in few countries and used primarily to compensate researchers for low salaries and to improve neglected infrastructure (12).

In spite of the importance of agricultural research in Africa (12) few African nations support sufficient numbers of researchers required for the functioning of a scientific discipline (13), and collaboration with regional scientists is minimal (7, 10, 14, 15). In addition, unfavorable currency exchange rates and the systemic underfunding of university libraries in sub-Saharan Africa have resulted in poor access to the world's scientific literature (16-18).

The Essential Electronic Agricultural Library (TEEAL) was developed at the Albert R. Mann Library at Cornell University to improve the quality and effectiveness of agricultural research in low-income countries. TEEAL is a large collection of research articles from over 200 leading scientific journals, sold for a nominal fee to educational and non-profit institutions located in the poorest countries around the world as determined by the World Bank. The selection of content for inclusion in TEEAL was based on core literature studies in agriculture and allied fields (19).

TEEAL was created on the premise that increased access to the scientific literature allows researchers to improve their own research, teaching, and outreach programs (20-23). Launched in 1999, TEEAL was shipped to subscribing institutions as a collection of CD-ROMs. Since 2005, the product is now sent as a portable hard-drive and may be installed on a local area network. Since TEEAL does not require access to the Internet, it is preferential for institutions with limited or no connectivity—this is the current situation throughout much of sub-Saharan Africa (9)—and is considered a "bridge technology" until Internet access in these regions becomes more accessible (20).

Survey, interview and bibliometric indicator research suggests that TEEAL is effective in meeting its goals. According to a survey of researchers at TEEAL institutions, the overwhelming majority of respondents (80%) reported that TEEAL was useful in their research, and 66% agreed that access to the current literature has influenced the conduct of their research (23). In-depth interviews of TEEAL users also confirm that access to the product is having positive influences on the lives of scientists, many of whom associate their higher publication rates—especially in prestigious international journals—with the use of TEEAL.

Prior studies show inconclusive results

Article production in TEEAL institutions has increased since implementation (23), suggesting that TEEAL may be responsible for the effect. Article production increases have been attributed to other scientific literature programs as well. For example, countries eligible for free or highly-discounted online journal articles through Research4Life—an organizational umbrella for HINARI, AGORA and OARE (24)—have nearly tripled their production of peer-reviewed articles according to the project organizers (25).

However, other studies on the effects of free and discounted access to the scientific literature show inconclusive results (26). A regional study of citation patterns to journals contained in HINARI and AGORA before and after program implementation reports mixed results (27). In some regions, citations to the participating journals increased, while in others, they decreased. No systematic geographical pattern was reported. A large global citation analysis suggests that researchers in low-income countries are benefiting from free access programs (28) although randomized controlled trials of open access publishing demonstrate null effects (29-31). A comparison of Indian with Swiss researchers illustrates that Indian researchers cite fewer papers and cite more articles published in open access journals than their Swiss counterparts (32), although two studies of biology journals show no preferential citation behavior for researchers in developing countries (33, 34). And while poorer regions of the world show clear benefits from online access to business and economics journals, they show no disproportional benefits over the rest of the world (35).

Isolating inputs and outputs

Scientific research is a comprised of many related inputs and outputs (2, 3, 36-40). As a result, it is often difficult to isolate and measure the impact of an intervention, such as TEEAL, from all other confounding variables. Many of the prior studies involve little more than rudimentary comparisons.

This paper investigates the impact of TEEAL on subscribing institutions in sub-Saharan Africa. It attempts to disambiguate the effects of TEEAL from exogenous effects such as time, institutional and country effects, as well as self-selection effects with careful matching and controlled analyses.

Methods

This study estimates the impact of TEEAL on scholarly literature produced by authors located in universities in sub-Saharan Africa. Specifically, we measure three bibliometric indicators of scholarship: 1) article production; 2) reference length (i.e. number of references per article); and more precisely, 3) the number of references made in each article to journals included in the TEEAL package. As TEEAL is sold only to institutions (not to individual authors or countries) the unit of comparison is the *institution*.

In order to isolate the effects of TEEAL on citation behavior, we compare the changes of institutions who have access to TEEAL (the intervention group) with two separate control groups: 1) institutions without TEEAL (referred to as the "non-subscribing control group"), and 2) institutions that have recently purchased but have not implemented TEEAL (referred to as the "self-selected control group"). As institutions were not randomly selected to receive TEEAL, we should not assume that the characteristics of the TEEAL institutions are similar in all respects to non-TEEAL institutions. The willingness and ability to purchase TEEAL may be associated with institutions with more access to resources and a stronger emphasis on research and publishing. This second self-selected control group is important in our analysis as it helps to distinguish *access* to TEEAL from *ability and willingness to acquire* TEEAL.

We use a repeated-measures design to compare the publication output of institutions *before* and *after* TEEAL implementation. The repeated-measures design has several benefits over an independent-measures design. By matching institutions with themselves, the repeated-measures design eliminates the variation that exists between institutions. It is therefore more sensitive to detecting changes within institutions over time (41).

To be included in the dataset, a country must have at least one institution that had purchased TEEAL prior to 2009 and at least one control institution. Several countries were excluded from our study because they did not meet these conditions: Cameroon, Mozambique, and Rwanda (no TEEAL institutions with an implementation prior to 2009); and Swaziland (no control institutions). In addition, institutions included in the analysis must have had at least one article indexed in Thomson Reuters' *Web of Science* (WoS) during the observation period. 45 institutions that did not meet this requirement were excluded.

The observation window for TEEAL institutions was determined by the year they purchased the product. On each side of the purchase date, we created a symmetrical *before* and *after* observation window. For example, if the institution first purchased TEEAL in 2001, we consider the *after* period to include 2002 through 2009 and the *before* period to include 1993 through 2000 (both 8-year windows). For countries with only one TEEAL implementation, we use the same dates to determine the observation windows for control institutions. For institutions with two or more TEEAL implementations, we take the average window length of the TEEAL institutions, round to the nearest year, and apply it to the control institutions. For example, Ethiopia has three TEEAL institutions that purchased the product 8, 3 and 2 years ago. We take the average of these three implementation dates (4.3) and round down to 4 to determine the observation periods for control institutions in Ethiopia.

The resulting dataset is composed of 19,753 article publications and 497,437 references from 70 institutions in 11 African countries between 1988 through 2009. Twenty-nine institutions formed the intervention cohort, 23 institutions without TEEAL formed the non-subscribing control group, and a further 18 institutions formed the self-selected control group. A list of institutions by country with publication numbers in each window is found in Appendix A.

This study tests three separate, but related, hypotheses:

1. Does article production increase at TEEAL institutions?
2. Do authors at TEEAL institutions cite more references in their articles?
3. Do authors at TEEAL institutions cite more TEEAL journals in their articles?

Article production is measured by the number of articles published by an institution's authors over the observation period. Institutional affiliation was determined by WoS's organization (OG) field tag, which indexes institutions named in the address field. In the case of collaboration across institutions, the article was counted for all named institutions. The number of references per published paper was extracted from WoS's article metadata. Lastly, in order to determine whether authors are citing TEEAL journals, we wrote a

lookup program that matched the journal abbreviation listed in an article's citation list to a list of journals included in the 2010 TEEAL product. While the number of titles in the TEEAL product has been growing over time—from an initial list of 140 journals in 1999 to 209 journals in 2010—the effect of matching older citations with a current TEEAL journal list may result in the detection of some false-positive citations. As the nature of our study is comparative, we are interested primarily in estimating the citation differences between subscribing and non-subscribing institutions—not their absolute numbers. As a result, misclassifying some earlier citations will have negligible effects on our results. If misclassifying does lead to bias, it will result in underestimating the true effect of the TEEAL intervention.

Our three hypotheses are *directional*, as we do not preconceive TEEAL ownership to have negative effects. We therefore consider our statistical tests as one-sided and set acceptable evidence for rejecting the null hypotheses at alpha=0.05.

Hypothesis 1 (testing the change in article production) was accomplished by a t-test for related samples, which was used to test the difference in production *after* versus *before* TEEAL implementation. A subsequent ANOVA tests this difference across groups (TEEAL-subscribing institutions and both control groups).

Hypothesis 2 (testing the change in length of article references) was accomplished by building a linear regression model with number of article references as the dependent variable. In this model, both the *TEEAL Group* and the *Self-selection Control Group* (both dummy variables) are compared to the *Non-subscribing Control Group*. *Publication Year*, (a continuous variable) is used to control for general inflation in reference length over time—a phenomena that has been well-documented in the literature (42, 43). *After Implementation* (AI) is a dummy variable, which serves to specify the window of observation after TEEAL implementation. Lastly, two interaction variables are included in the model, *AI*TEEAL Group* and *AI*Self-selection Control,* both of which serve to measure the change on the dependent variable (*Reference Length*) after TEEAL implementation. If TEEAL implementation has an effect on the reference length of papers, we should see a positive and significant effect for the *AI*TEEAL Group* variable. Last, we control for institutional-level and country-level effects by specifying these as categorical variables in our model. Since institutions are located within countries, we create a multilevel model (44) such that the variation within institutions is nested within their hosting countries. We specify *Institution* and *Country* as random variables (rather than fixed variables) because we are chiefly interested in controlling for these effects in our model rather than arriving at specific estimates for each of our 70 institutions and 11 countries. Moreover, because of the sheer number of institutions in our study—many of them small—we run the risk of

detecting significant differences for several of them by pure chance. We therefore report only the variance components for *Institution* and *Country* and how much variation these variable can explain in the overall analysis.

Hypothesis 3 (testing the references to TEEAL journals) was accomplished by building a model similar to hypothesis 2, but with *TEEAL References* as the dependent variable.

Considering the size of our dataset, we attempted to build more complex models to discern heterogeneous effects at the country and regional level, or to discern the effects of institution size, date of adoption, and combinations of the aforementioned. Unfortunately, high correlation among many of these variables resulted in unstable regression models and potentially biased estimates. As our data was based on counts, we also analyzed our data using a Poisson model and came to similar results without providing any additional information of interest. We therefore present our simple linear models for each hypothesis.

Results

Controlling for institutional, country, time, and self-selection effects, ownership of TEEAL does not result in higher article production, although it does lead to longer reference lists and a greater frequency of citations to TEEAL journals.

Article Production

Article publication increased significantly across all groups in our study, from 98 publication per institution in the *before* window to 184 publications in the *after* period, a mean difference of 86 publications ($t(69)=4.8$, $p<0.0001$, $r^2=0.86$)(Table 1). While subscribing institutions published, on average, more articles before TEEAL implementation than institutions in the control groups, TEEAL institutions did not outperform the control institutions during the course of the study ($F(2)=0.08$, $p=0.92$). Article production increased, on average, by 94 articles for TEEAL institutions, 77 articles for non-subscribing control institutions, and 86 articles for self-selected control institutions.

Number of References

While reference length increased generally over the period of the study, papers from TEEAL-subscribing institutions grew larger than control institutions. Papers from TEEAL institutions grew by an average of 7.47 references per paper, compared to 3.47 for non-subscribing institutions, and 5.00 for self-selecting control institutions (Table 2). Holding all other variables constant in our regression analysis, papers from subscribing institutions grew by 2.58 references (95% CI 1.57—3.58, p<0.001) after TEEAL implementation compared to the non-subscribing control group (Table 3). In contrast, papers from the self-selection control group displayed no statistical change over the same period (1.08, 95% CI -0.19—2.36, p=0.097). General inflation could explain an increase of 0.82 references per year (95% CI 0.74—0.91, p<0.001). Differences among institutions accounted for nearly 2.5% of total variation and differences among countries explained an additional 1.7%.

Number of References to TEEAL Journals

After implementation, authors at subscribing institutions cited more TEEAL journals than authors located in both control groups. Authors at subscribing institutions cited 0.69 more TEEAL journals per paper over the course of the study compared to 0.15 more TEEAL citations per paper for authors located at non-subscribing control institutions and 0.23 more TEEAL citations for authors located at self-selecting control institutions (Table 2). Holding all other variables constant in the regression analysis, authors located at subscribing institutions cited 0.42 more TEEAL journals (95% CI 0.22—0.62, p<0.001) after TEEAL implementation, compared to the non-subscribing control group (Table 4). The self-selection control group displayed no statistical change over the same period (0.19, 95% CI -0.06—0.44, p=0.134). General annual inflation could explain an increase of 0.16 more citations to TEEAL journals per year (95% CI 0.04—0.08, p<0.001). Institutional variation explained 23% of total variation and country variation explained an additional 3%.

Discussion

Controlling for institutional, time, and self-selection effects, ownership of TEEAL does not result in higher article production, although it does lead to longer reference lists and a greater number of citations to TEEAL journals.

General inflation in the publication of scientific articles, even for non-subscribing institutions (Table 1), suggests that prior claims attributing large production increases to journal access programs (25) may be greatly overstated.

Access to relevant research literature is but one limiting resource to scientists in low-income countries, but it is not the only one. In order to conduct empirical research, one must have access to equipment, materials and facilities, trained researchers and technicians, and the infrastructure necessary to support and coordinate them all. Authors must be able to analyze their results, present their findings, and communicate them clearly and coherently in a language that may not be the author's native tongue. Once submitted, scientific manuscripts must make it through peer-review and be published in an indexed journal in order to be visible to those conducting the evaluation. The fact that we detect increases in citations, but not article production, suggests that access to the scientific literature is not sufficient to increase the production of new scientific knowledge for researchers in sub-Saharan Africa.

We report that scientific authors, when exposed to a new collection of journal articles, will demonstrate a small, but detectable, propensity to cite those journals. In addition, exposure to new articles makes authors more likely to include references to the broader corpus of scientific literature. This suggests that the scientific article function in two ways: 1) to deliver new findings to the reader; and 2) to direct the reader—through referencing—to other relevant research on the topic.

Our inability to detect an increase in publication output through bibliometric analysis conflicts with survey and interview results from the users of TEEAL themselves (23), many of whom attributed higher publication rates—especially in prestigious international journals—to their use of TEEAL. Our inability to detect publication increases within our dataset may indicate the existence of various survey biases, for example, *response bias*, *acquiescence bias*, and *social desirability bias* (45, 46). Our analysis does reveal high variability among institutions, especially with respect to the number of citations to TEEAL journals (Table 3), suggesting the TEEAL may be having differential effects among subscribing institutions.

Study Limitations

Scope of observation. While Web of Science does not index the entire corpus of research literature, it does provide a reliable sample of citations comparable to other citation counting services such as Scopus (47, 48). As our study was comparative in nature and did not rely on estimating complete publication and citation counts, Web of Science should be sufficient for answering our research questions. Alternative indexes such as CABI were considered but rejected on the basis that they didn't index cited references. As African authors show preferential authorship and citation biases toward international journals (7, 49-52), a subsequent study of regional journals is therefore unlikely to yield different results.

Subject scope. TEEAL is a collection of journals focused on agriculture, and as such, does not provide comprehensive access to all scientific disciplines. While the collection of journals is very broad in scope and includes important titles in engineering, medicine, biology, chemistry, economics and social sciences, among others, the inclusion of articles in our dataset that have no relevance to the journals included in TEEAL may attenuate any observed effect.

Access not a precondition of citation. An author may cite from the abstract of an article or simply copy a reference from another paper (53, 54). The result of this behavior may also underestimate any access-citation effect.

Other avenues of access. While TEEAL is the oldest of the collaborative publisher programs, researchers may have access to other free and discounted journal access programs designed for researchers in low-income countries (e.g. AGORA (21); HINARI (55); OARI (24); Free Access to Developing Economies (56); AJOL (57-59). Indeed, most publishers participate in several programs simultaneously (60). As well, researchers may find informal avenues of access to the journal literature, such as requesting copies of articles from the author or from peers at other institutions (32, 61), and by relying on freely-accessible copies of articles self-archived in digital repositories (62, 63). Alternate avenues of access may make it more difficult to isolate the effect of TEEAL specifically on citation behavior.

Access to these competing services may be hampered by poor access conditions, however. By mid-2004, only 51 of the nearly 250 institutions registered to use AGORA had attempted to download any articles (23). Even today, reliable Internet access is still limited in most institutions in sub-Saharan Africa (9), a situation that justifies the persistence of an offline journal access program until Internet connectivity greatly improves (20).

Access to TEEAL at subscribing institutions. Owning TEEAL does not necessarily mean that researchers have adequate access to the service. User surveys of TEEAL have identified several obstacles to using the product, including access to the physical library where the product is usually installed, inadequate number of computers, the cost of printing, as well as language and training barriers that reduce the effectiveness of the product (23, 64). In a related study of the use of HINARI, doctors and researchers expressed frustration with retrieving login passwords from their librarians who served often as gatekeepers to online journals (61).

Science Indicators. Lastly, while the effectiveness of new scientific policies and programs are often measured through bibliometric indicators, we should understand that these indicators provide only a limited view and must be supplemented by other indicators in order to create a more complete picture of the state of research in low-income countries. The transfer of scientific knowledge to society is facilitated through many communication channels. By measuring what researchers publish and cite, we are only able to observe the *formal* communication of scientific results to other scientific researchers. If we are to paint a more complete picture of knowledge transfer, we must also examine indicators that measure the informal transfer of scientific knowledge through reading, teaching, outreach and policy formation (26).

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Tables and Figures

Table 1. Publication output *after* versus *before* TEEAL implementation

Difference: After-Before at the Institutional Level			
All Groups (N)	70		
After (mean)	184	t-Ratio	4.8
Before (mean)	98	DF	69
Mean Difference	86	Prob > t	<.0001
Std Error	18		
Upper 95%	122		
Lower 95%	50		
Correlation	0.86		

Across Groups				
Institution Type	N	Mean Before	Mean After	Mean Difference
TEEAL	29	134	228	94
Non-subscribing Control	23	80	156	77
Self-Selection Control	18	64	149	86

Test Across Groups	F Ratio	Prob>F	
Mean Difference	0.08	0.92	Within Pairs
Mean Mean	0.80	0.45	Among Pairs

Table 2. Mean number of references before and after TEEAL implementation

	Reference Length (mean)			TEEAL references (mean)		
Institution Type	Before	After	Difference	Before	After	Difference
TEEAL Group	21.23	28.70	7.47	1.08	1.77	0.69
Non-subscribing Control Group	21.81	25.28	3.47	0.93	1.08	0.15
Self-selecting Control Group	21.16	26.16	5.00	1.21	1.44	0.23
All	21.37	27.21	5.84	1.06	1.51	0.45

Table 3. Estimating the effect of TEEAL on length of reference list in published papers.

Fixed Effect	Estimate	t Ratio	Prob>|t|	Lower 95%	Upper 95%
TEEAL Group	-0.51	-0.49	0.623	-2.58	1.56
Self-selection Control Group	-1.29	-1.18	0.244	-3.49	0.91
Publication Year	0.82	18.96	<.0001	0.73	0.90
After Implementation (AI)	-2.30	-4.45	<.0001	-3.31	-1.29
AI*TEEAL Group	2.58	5.01	<.0001	1.57	3.58
AI*Self-selection Control	1.08	1.66	0.097	-0.19	2.36

REML Variance Component Estimates

Random Effect	Variance Component	95% Lower	95% Upper	% of Total
Institution[Country]	5.05	2.95	10.56	2.47
Country	3.54	1.37	21.84	1.74
Residual	195.40	191.59	199.32	95.79
Total	203.99			100

N=19,753; Mean response=25.18; Model RSq=0.10

TEEAL Group and Self-selection Control Group effects are reported against the Non-Subscribing Control Group.

Table 4. Estimating the effect of TEEAL on the number of citations to TEEAL journals in published papers.

Fixed Effects	Estimate	t Ratio	Prob> t	Lower 95%	Upper 95%
TEEAL Group	0.05	0.09	0.929	-1.02	1.11
Self-selection Control Group	0.02	0.03	0.974	-1.08	1.12
Publication Year	0.06	7.26	<.0001	0.04	0.08
After Implementation (AI)	-0.42	-4.13	<.0001	-0.62	-0.22
AI*TEEAL Group	0.42	4.19	<.0001	0.22	0.62
AI*Self-selection Control Group	0.19	1.5	0.135	-0.06	0.44

Random Effect	Variance Component	95% Lower	95% Upper	% of Total
Institution[Country]	2.32	1.56	3.81	23.07
Country	0.33	0.08	44.84	3.26
Residual	7.40	7.26	7.55	73.67
Total	10.05			100

N=19,753; Mean response=1.35; Model RSq=0.08

TEEAL Group and Self-selection Control Group effects are reported against the Non-Subscribing Control Group.

Appendix A.

Publication counts by institution, type and country

			Analysis Window		
Inst Type	**Country**	**Institution**	**Before**	**After**	**Total**
TEEAL	Ethiopia	ARARI	2	6	8
		Haramaya University	0	56	56
		Mekelle University	17	78	95
	Ghana	Kwame Nkurumah University on Science and Tech (KNUST)	38	63	101
		University of Development Studies (UDS)	25	19	44
		University of Ghana	178	249	427
	Kenya	Egerton University	72	275	347
		Jomo Kenyatta University of Agriculture & Tech (JKUAT)	30	176	206
		Kenyatta University (KU)	132	459	591
		University of Nairobi (UoN)	727	654	1381
	Lesotho	National University of Lesotho	29	68	97
	Malawi	University of Malawi, Bunda College of Agriculture	12	14	26
	Nigeria	Ahmadu Bello University NAQAS and Faculty of Agriculture	258	374	632
		Bayero University	6	38	44
		Michael Okpara Univ of Agric-Umudike	0	116	116
		Obafemi Alowolo University	578	1031	1609
		University of Agriculture-Abeokuta	27	14	41
	Swaziland	University of Swaziland	52	91	143
	Tanzania	Sokoine University of Agriculture and Solomon Mahlangu Campus	205	390	595
		University of Dar Es Salaam - Institute of Marine Sciences	99	132	231
	Uganda	Makerere University	294	1127	1421
	Zambia	University of Zambia	110	209	319
	Zimbabwe	Africa University	4	6	10
		Bindura University of Science Education	6	20	26
		Chinhoyi University of Technology	1	3	4
		Midlands State University	0	14	14
		Solusi University	1	0	1
		University of Zimbabwe	989	920	1909
		Women's University in Africa	1	0	1
	Subtotal		3893	6602	10495
Non-subscribing control	Ethiopia	Addis Ababa University	423	581	1004
		Bahir Dar University	2	33	35
		Hawassa University	0	6	6
	Malawi	Mzuzu University	0	5	5
	Nigeria	Babcock University	0	26	26
		Delta State University	38	138	176
		Federal University of Technology-Akure	61	314	375
		Kaduna State University	0	1	1
		Kano University of Science and Technology	0	3	3
		Ladoke Akintola University	54	224	278
		Olabisi Onabanjo University	2	258	260
		University of Abuja	13	33	46
		University of Benin	327	534	861
		University of Calabar	205	216	421
		University of Jos	164	183	347
		University of Maiduguri	175	176	351
		University of Port Harcourt	120	248	368
		University of Uyo	66	169	235
		Universty of Ilorin	170	338	508
	Tanzania	Open University of Tanzania	2	6	8
	Uganda	Kyambogo University	0	16	16
		Mbarara University of Science and Technology	9	74	83
	Zambia	Copperbelt University	3	10	13
	Subtotal		1834	3592	5426

Self-selection control	Ethiopia	Adama University	0	3	3
		Jimma University	21	71	92
	Ghana	University of Cape Coast	24	26	50
	Kenya	Maseno University	8	110	118
		Masinde Muliro University of Science and Technology	0	8	8
		Moi University	125	260	385
	Nigeria	Abubakar Tafawa Belawa University	48	44	92
		Bowen University	0	37	37
		Ebonyi State University	3	82	85
		Federal University of Technology-Owerri	46	166	212
		Ibadan University	655	1362	2017
		Imo State University	20	50	70
		Joseph Ayo Babalola University	0	2	2
		Rivers State University of Science and Technology	118	171	289
	Uganda	Gulu University	0	13	13
		Uganda Martyrs University	0	3	3
	Zimbabwe	National University of Science and Technology	74	275	349
		Zimbabwe Open University	3	4	7
	Subtotal		1145	2687	3832
Grand Total			6872	12881	19753

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