

Commitment to Global Open Access Transition Collaboration: Outcomes and Lessons from SCOAP3- Korea

Youngim Jung* 

KESLI Secretariat, Korea Institute of Science and Technology
Information (KISTI), Seoul, Korea
Data & HPC Science, University of Science and Technology, Seoul,
Korea
E-mail: acorn@kisti.re.kr

Hwanmin Kim 

KESLI Secretariat, Korea Institute of Science and Technology
Information (KISTI), Seoul, Korea
E-mail: mrkim@kisti.re.kr

ABSTRACT

Eight years have passed since the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP3) was launched. SCOAP3 is one of the most successful global partnerships and funds for Open Access and has been benchmarked by other Open Access initiatives. The Korea Institute of Science and Technology Information (KISTI) joined as the first Asian partner in 2011, and has supported its shared vision and contributed its financial commitment since the beginning of SCOAP3. SCOAP3-Korea is the first bottom-up collaboration for local libraries to re-direct funds previously used for subscriptions to Open Access publishing. This paper explores the roles and responsibilities of KISTI in the Open Access quest. It describes the commitment to SCOAP3 in South Korea, including how the collaboration model for SCOAP3-Korea differs from the global model. This paper also discusses the impact of SCOAP3-Korea by analyzing publications affiliated by Korean authors in SCOAP3 journals for the last six years (2014-2019). We have integrated the national R&D project and research outcome data from NTIS (National Science and Technology Information Service) to investigate the research articles benefited by SCOAP3 and research publications in non-SCOAP3 journals. The positive impact of SCOAP3 in increasing research publication in the discipline was revealed compared to non-SCOAP3 journals. In addition, the financial benefit of SCOAP3-Korea has been proven. With regard to the investment for readers, \$137,094 USD was saved during the SCOAP3 Phase 1 and 2, while \$748,923 USD was saved with regard to publication fees. We discussed the lessons from SCOAP3-Korea for commitment to a larger-scale Open Access transition.

Keywords: SCOAP3, SCOAP3-Korea, open access transition, outcomes and lessons

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***Corresponding Author:** Youngim Jung
 <https://orcid.org/0000-0001-7924-6967>
E-mail: acorn@kisti.re.kr



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1. INTRODUCTION

South Korea is one of the heaviest investors in and an active producer of scientific R&D. South Korea has spent the highest GERD/GDP (gross domestic expenditure on R&D/gross domestic product) (4.64%) among the G20 in the previous years including 2021. The total number of publications in Web of Science (WoS) for the last ten years (2011-2020) is 592,873, ranking eleventh among the G20 as of 2021. The academic outputs are strong in engineering, reflecting excellent private sector funding and activity. Open Access policy at the national or institutional level has been highlighted as the key driver in increasing the Open Access publishing percentage of its research output (de Castro, 2022). Open Access output is strong across all disciplines except life sciences and social sciences in South Korea. Open Access publishing is rising in all areas (Adams & Rogers, 2021), though there is neither national policy nor funders or institutional promotion of Open Access policy developed in South Korea so far. Only one institution in South Korea has opened and registered its Open Access policy via ROARMAP as of April 15, 2022.¹

Despite the absence of a national Open Access policy, the goal of Open Access to provide anyone, anywhere, and anytime free access to the result of scientific research in digital format using the Internet has been well received by Korean researchers. Global movements and perspectives on Open Access have been shared with the library community through seminars and workshops and annual conferences hosted by opinion-leading organizations such as the Korea Institute of Science and Technology Information (hereafter KISTI) and the Korean Association of Medical Journal Editors since the early 2000s, and more recently by the National Library of Korea. For about two decades after the first Berlin Conference, there have been parallel and fragmented Open Access initiatives in various forms but they have not exerted any transformative pressure on the subscription system (Schimmer, 2017). Likewise, the efforts for moving research towards Open Access have been made in a fragmented way in South Korea and so the Open Access projects conducted by various stakeholders have not inspired the scholarly community as well as the publishing industry until recently. Research funders have stood apart from journal subscription issues. Funders have encouraged domestic journals to provide Open Access. Yet contrarily, they have given enormous incentives to researchers who publish their articles in so-

called prestigious journals and academic societies who make their journals successfully indexed in SCIE, SSCI, and A&HCI indexes regardless of whether they are pay-walled or not. Due to the absence of institutional Open Access policy, libraries, having spent their budget for readers, have had little motivation to remedy their expenditure scheme without proven evidence of Open Access benefits.

However, Plan S, launched in 2018 by cOAlition S, a consortium of national research agencies and funders, changes the landscape of the scholarly ecosystem fundamentally and affects it globally. This is a timely moment for the whole research community in South Korea to set up shared goals and establish practical strategies toward Open Access transition. Particularly, in order to achieve a shared goal of transition to Open Access for the benefit of research and the public good, networked efforts across the border on the globe, and commitments to transparency in the matter of costs and benefits to the research community based on data-driven evidence is highly required. Thus, this study examines the well-tested collaboration structure and the financing model indicated by the Sponsoring Consortium for Open Access Publishing in Particle Physics (SCOAP3) and suggests SCOAP3-Korea, a customized model responding to the local need: to present the outcomes, benefits, and limitations of SCOAP3-Korea based on the data analysis to draw implications for envisioning the Open Access transition at a larger scale covering all major disciplines. The rest of this article is structured as follows. Section 2 describes the global context of Open Access and the Open Access movements in South Korea. Section 3 starts with a brief overview of SCOAP3, then illustrates the SCOAP3-Korea model, and analyzes the benefits of SCOAP3-Korea to the research community. Section 4 discusses limitations of the study and implications of SCOAP3-Korea for extended Open Access transitions. Conclusions follow at the end.

2. PREVIOUS STUDIES

2.1. Open Access as Game Changer in Scholarly Communications

With the wide adoption of the Internet and the development of digital technology, digital publishing has been expected to be a solution for disseminating knowledge at a much lower cost and as an optimistic prospect for institutions facing serial budget cuts. Yet other researchers have pessimistically speculated that digital distribution would

¹<http://roarmap.eprints.org/view/country/410.html>

be no solution at all. The growth and the impact of large commercial publishers was observed through the investigation of 45 million articles indexed in the WoS for the 1973-2013 period (Larivière et al., 2015). The European University Association (EUA) conducted the EUA Big Deal Survey and the overall Big Deal costs reported a total of 82 subscription contracts and over 90% of periodicals expenditure concentrated in the top three publishers, Elsevier, Wiley, and Springer. Large scientific publishers have created steady profits while university sectors are under severe financial strains (Morais et al., 2018). Open Access has been regarded as the new driving force to change the landscape of the scholarly ecosystem by removing barriers for the whole society to access scientific assets and provide faster solutions for responding to global issues such as pandemics, climate change, and others, accelerating knowledge learning and sharing, enhancing openness and transparency in scientific research, increasing the reusability of scientific publications, recovering control over scholarly publishing from large commercial publishers, and bringing new opportunities for smaller and society publishers to be revisited.

Using one terminology, a number of approaches, models, and initiatives have been designed and tested with varying objectives. The fragmented and unconnected initiatives have all been limited in scope and impact, and the subscription system still prevails and is even in good shape (Schimmer et al., 2015; Vacek & Kaliaperumal, 2022). At the 12th Berlin Open Access Conference OA2020, a global project to realize the transition to full and immediate Open Access was launched. This project has grown steadily, collecting signatures from all over the world. The OA2020 team have suggested the practical methodology for libraries to engage in the transition to Open Access, the so-called “transformative agreement.” The announcement of Plan S was initiated by funders followed three years after, which has formed collective and powerful forces to impose new rules in scholarly communications and accelerate the transition to Open Access on a large scale (Momeni et al., 2021; Smits & Pells, 2022). Currently, making research open as a matter of principle seems obvious to most members of the scholarly community. Even if a funding body never explicitly joins in Plan S, many of them have supported other programs with the same goal. The firm stance toward full Open Access taken by libraries and funders controlling cash flow to commercial publishers has urged the fundamental changes in publishers’

attitudes. COVID-19, the unprecedented pandemic crisis, has shown that publishers have conceded to Open Access (Smits & Pells, 2022; Szomszor & Quaderi, 2020).

2.2. Roles and Responsibility of KISTI in Open Access Quest

KISTI, as the only research organization designated by the Science and Technology (S&T) Framework Act for establishing a National S&T infrastructure, has its mission (1) to develop national S&T data platforms and content curating applications, (2) to provide infrastructure for national research data management, and (3) to implement an integrated portal of national R&D information. KISTI has played a significant role in promoting and implementing Open Access in South Korea. In January 1997, the Information Center for Physics Research (ICPR) at Seoul National University, financially supported by the Korea Science and Engineering Foundation (currently, National Research Foundation of Korea [NRF]), constructed a mirror site of the Los Alamos National Laboratory Preprint Archive (currently, arXiv). KISTI conducted a survey on Korean researchers’ awareness of and attitudes to Open Access. With the bilateral agreement on information exchange between ICPR and KISTI, Science Attic was launched in 2006 in order to provide Open Access to preprints of domestic S&T research outputs.² Although the South Korean mirror (formerly kr.arXiv.org) has been discontinued since 2008 due to discontinuous support for the mirror site operation and the policy change in the mirror network of arXiv,³ the level of awareness of and involvement in Open Access from the Korean research community has been high.

The Korean government has emphasized the development and expansion of ICT (information and communication technology) infrastructures and led informatization projects actively since the early 1990s. The Ministry of Science and Technology initiated the Academic Society Informatization Projects in 1996 aiming at the digitization of scholarly publications and records and the informatization of scholarly activities within academic societies. KISTI has taken the responsibility of converting scholarly publications in print format to digital format to a large scale, providing websites (both for the societies and for the journals), and e-mail accounts, hosting those websites, and operating the KREONet. The academic societies have agreed on the provision of public access to their digitized scholarly publications through a portal service named

²<http://icpr.snu.ac.kr/>

³<https://arxiv.org/help/mirrors>

Society Village, operated by KISTI (Choi et al., 1999). The first Korean prototype system for automatizing the editorial process was designed by KISTI in 1999. The Article COntribution Management System (ACOMS) has updated its version and has been utilized by more than a hundred domestic academic societies up to today. ACOMS is distributed free of charge for academic societies who lack the capacity to develop their own peer-review system and suffer from insufficient budgets and personnel resources for managing their scholarly publishing. ACOMS has contributed to collect scholarly publications and records from the submission stage and has provided free access to those journals' articles for Korean researchers and citizens (KISTI, 2002). In 2009 the first national Open Access project, Open Access Korea (OAK), was initiated by the Ministry of Culture, Sports, and Tourism of Korea. This project was performed by KISTI for five years.⁴ The two routes of Open Access were discussed and implemented; for Green Open Access, a suite of institutional repositories and linking services to the central system, OAK Portal, was developed and distributed to universities, research institutions, and public organizations. In order to pave the forward to the Golden route, information on Open Access journals in South Korea was collected and provided through OAK Central. The creation of JATS XML for a set of selected Open Access journals was supported by KISTI.

In addition, a series of seminars and conferences took place to provide domestic librarians and researchers with an open forum for discussing global trends in scholarly communication and Open Access in the Korean context. At the 2010 Open Access Conference, SCOAP3 was introduced as the global partnership for sponsoring Gold Open Access (KISTI, 2012). In 2011, KISTI joined SCOAP3 as the National Contact Point of South Korea. As the first Asian partner, KISTI has resonated with the voice of the global Open Access initiative across the border and supported the conversion of key journals in high energy physics to Open Access.⁵ For South Korea, SCOAP3 is the first project to convert journal articles published in paywall journals to Open Access. Due to the absence of national, institutional, and funders of Open Access policy, Korean researchers have agreed to transfer copyright and assign exclusively to publishers all rights when they publish their articles, which are mostly outcomes funded from the national R&D programs. KPubS, the Open Access publishing platforms of domestic science and technology

journals, has operated since 2014. In 2019, KISTI contributed to the signing of the contract for the conversion of 25 research institutes between the National Research Council of Science and Technology (NST) and Elsevier for the first time in Korea. After this transformative contract, more members in scholarly communication in South Korea have involved in the discussion for moving forward to Open Access.

In June 2021, three members of the National Assembly of Korea agreed on the need for further review of related bills and the formation of public opinion on Open Access transition, and collaborated with NRF, KISTI, and the Korea Federation of Science and Technology (KofST) in co-hosting National Open Access Policy Forum 2021. Two months later, six organizations representing national research funders and public and academic information services, including NRF, KofST, KISTI, Korea Education and Research Information Service, National Library of Congress, and National Library of Korea agreed to release a joint statement on Open Access in order to reassert their collaboration and commitment to advance the Open Access agenda within the nation-wide context. Critical issues addressed in the joint statement include the provision of infrastructure for Open Access, mandates for Open Access to public-funded research articles, support for flipping domestic journals to Open Access, implementation of Open Access transformative agreements (TA), support for researchers and academic societies to retain copyright, avoidance of predatory publishing practices, and commitment to global Open Access initiatives.⁶ Particularly, more voices from various bodies with regard to supporting Open Access publishing in international journals have been shared nationwide and aroused sympathy.

As mentioned in the Introduction, South Korea is an active producer in WoS indexed journals, ranking eleventh among G20, and Korean researchers favor publishing their articles Open Access even in the absence of specific policies and systematic support. To make a commitment to Open Access transition and to spend the R&D expenditure on Open Access publishing by Korean researchers more effectively, more various bodies and stakeholders need to convince of the benefit of Open Access at the national level based on the well-tested examples and related data. SCOAP3-Korea's being conducted and tested in the higher energy physics field over eight years will give implications for South Korea to make an informed decision

⁴The OAK project was transferred to the NLK in 2014 and is currently focusing on institutional repositories.

⁵Korea joins SCOAP3 – SCOAP3: <https://scoap3.org/news83/>

⁶https://www.nrf.re.kr/cms/board/subject/view?menu_no=95&nts_no=161762

in Open Access Transition at a larger scale.

3. SCOAP3 AND SCOAP3-KOREA

3.1. SCOAP3 in Global Context

SCOAP3 is a global partnership of libraries, research centers, funding agencies, and intergovernmental organizations, working to achieve equitable Open Access to research in high-energy physics through collective action (Bianco et al., 2007). CERN as a host organization operates SCOAP3 with participatory governance including more than 3,000 libraries, funding agencies from 45 countries, and three intergovernmental organizations.⁷ All these participants are part of SCOAP3. By design, this is a departure from so-called ‘author-pays’ models where authors, or their institutions directly, cover publication fees. Creating the ‘invisible infrastructure’ of SCOAP3, and in a comparable way, also the emerging national and institutional-wide agreements with selected publishers, aims to realize the largest amount of advantages for authors and readers in parallel. This, in turn, allows a fact-based approach for institutions, and libraries in their new role of managing Open Access therein, to articulate the shifting of publication costs and processes to a central institutional point rather than the author level. A guiding principle of SCOAP3 is to remove any barriers or burdens for authors to achieve Open Access and give any reader access to any article in the field.

As the host organization of SCOAP3, CERN has con-

tributed its human and financial resources to make this initiative sustainable and growing. Indeed, from its start in January 2014, more than 1,300 new universities from 28 countries and two intergovernmental organizations have joined SCOAP3 (Kohls & Mele, 2018). SCOAP3 has been regarded as one of the most successful projects pioneering global partnerships for Open Access transition and lowering the cost of Open Access publishing charges to 1,100 Euros. The best practices of SCOAP3 were benchmarked to set up the Roadmap for OA2020 (Schimmer, 2017). According to Larivière et al. (2015), the proportion of scientific articles in all STM (Science, Technology, and Medicine) fields except physics is concentrated in large commercial publishers. Only physics showed a different pattern: After increasing from 20% in 1973 to 35% in 2000, it has since then remained stable and is subsequently the discipline where the top five publishers account for the lowest proportion of papers published. The study assumed that arXiv, a preprint server of physics, mathematics, and computer sciences, and SCOAP3 contributed to make the field less profitable and thus less interesting for commercial publishers. SCOAP3 has sponsored society and university publishers as well as commercial ones to flip their journals to open access without economic barriers, as shown in Table 1.

3.2. Collaboration and Financing Model of SCOAP3-Korea

South Korea has shared the vision of SCOAP3 from

Table 1. SCOAP3 journals

Journal	Publisher	Publisher segment	SCOAP3 coverage	Group
Acta Physica Polonica B	Jagiellonian University	University	~10%	C
Advances in High Energy Physics	Hindawi	Commercial	~40%	B
Chinese Physics C	IOP Publishing & CAS	Society owned	~20%	B
European Physical Journal C	SpringerNature & SIF	Society owned	100%	A
Journal of High Energy Physics	SpringerNature & SISSA	Society owned	100%	A
Nuclear Physics B	Elsevier	Commercial	100%	A
Physical Review C	American Physical Society	Society	~10%	C
Physical Review D	American Physical Society	Society	60%~	B
Physical Review Letters	American Physical Society	Society	~10%	C
Physics Letters B	Elsevier	Commercial	100%	A
Progress in Theoretical & Exper. Phys.	OUP & JPS	Society owned	~50%	B

SCOAP3, Sponsoring Consortium for Open Access Publishing in Particle Physics.

⁷<https://scoap3.org/what-is-scoap3/>

the OAK conference held in 2010 and has contributed the national financial commitment since the beginning of SCOAP3. SCOAP3-Korea follows SCOAP3 in general. With the tripartite involvement of research libraries, an academic society, and publishers, KISTI has contributed to establishing a multi-lateral collaboration among stakeholders in South Korea and delivering on its objective “to provide open and unrestricted access to all higher energy physics (HEP) research literature” on behalf of the SCOAP3 global. The fair share principle is applied when calculating the institutional share of SCOAP3 journals for measuring its benefit as described in Section 3.3. However, the previous subscription fee and the share of publication of each institution is taken into consideration for assigning the institutional contribution. This mixed approach has been chosen by participating libraries since 2014 and was re-confirmed in the survey on the assignment of institutional SCOAP3 contributions conducted in 2018 (Lee, 2019).

From the beginning of SCOAP3-Korea to date, there has been no institutional Open Access policy established, as mentioned in the Introduction. Without any change in the institutional policy, libraries have difficulties in making a sole decision to re-direct their expenditures from subscriptions to publications and they want their institutional contribution based on the subscription, not on publication share. In order to meet the demands from participating libraries and potential participants, the institutional contribution is assigned as follows: (1) the contribution is assigned based on the subscription fee to ongoing participating libraries; (2) an even 0.5 weight is given for the subscription fee and the publication fee for calculating the contribution for potential participants who have subscribed to the target journal before; and (3) the institutional contribution is based purely on the share of publication in SCOAP3 journals for potential participants who never subscribed to the titles before, but their researchers have co-authored in publications of SCOAP3. For the purpose of promotion, the institutional contributions are offered at a 20% discount through the consortium. In addition, as an administrative framework, MOUs between KISTI and participating libraries are established upon each SCOAP3 phase. SCOAP3-Korea has been proposed as a consortium package to the KESLI consortium⁸ since 2014. SCOAP3-Korea is the first and only partnership among libraries aligned with the global initiative for supporting Open Access publishing in overseas journals

in South Korea. As SCOAP3 has contributed to the public good globally, SCOAP3-Korea has contributed to research communities in South Korea, as illustrated in Section 3.3.

3.3. Outcomes of SCOAP3-Korea for Phase 1 and 2 (2014-2019)

In this section, the effect of SCOAP3-Korea from various aspects is assessed. More specifically, the analysis is designed to answer the following research questions: (1) is the growth of research and research outcomes in HEP found?; and (2) Is SCOAP3-Korea cost-effective? For answering these questions, three types of data, including 1) SCOAP3 publication data, 2) cost data, and 3) R&D outcome data were used. Firstly, the publication data by authors who are affiliated with domestic research institutions in SCOAP3 journals for the last six years (2014-2019) were collected from the SCOAP3 repository. Secondly, data on subscription fees paid by each institution before SCOAP3-Korea was collected from the KESLI system and participating publishers. Lastly, the national R&D project and research outcome data (2009-2018) from NTIS was integrated to investigate the research articles benefited by SCOAP3 and research publications in non-SCOAP3 journals. We refined the affiliation name manually because the level of affiliation was different in each data source. R was utilized for conducting the descriptive and regression analysis.

3.3.1. The Growth of Research in Higher Energy Physics of South Korea

In order to examine the growth of research actors and outcomes in HEP during the SCOAP3 Phase 1 and 2, three types of basic statistics are generated as shown in Table 2 and Fig. 1. The number of articles, the number of authors affiliated to institutions in South Korea, and the number of institutions which the authors are affiliated to keep increasing for five years. The number of articles as of 2018 was 573, which doubled the number of articles in 2014. The number of domestic research institutions is steadily increasing from 33 in 2014 to 43 in 2018. The growth of articles and research actors in the field of HEP in South Korea presents the revitalization of research in the field.

We divided eleven journals supported by SCOAP3 into three groups as shown in Table 1. Group A refers to journals fully supported by SCOAP3, B to journals where from 10% to less than 100% of articles supported by

⁸<https://kesli.or.kr>

Table 2. Growth of articles, authors, and institutions during SCOAP3 (2014-2019) in South Korea

Growth	Year						Increase
	2014	2015	2016	2017	2018	2019.4 ^{a)}	
Number of articles	253	270	306	339	573	170	2.1x
Number of authors	2,888	3,384	4,135	5,439	9,075	2,850	2.7x
Number of institutions	33	37	41	41	43	37	1.2x

^{a)}The publication data for 2019 are not completely collected at the time of analysis. Data for articles up to April are available and presented as 2019.4 in the table.

SCOAP3, Sponsoring Consortium for Open Access Publishing in Particle Physics.

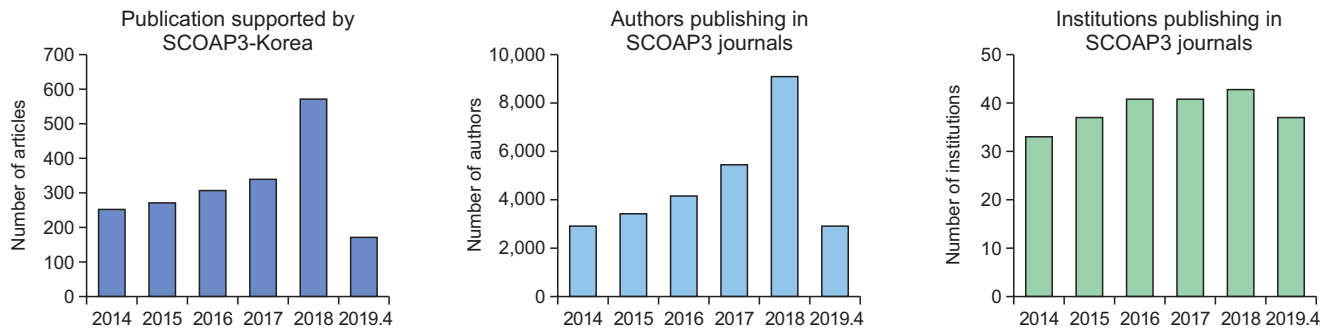


Fig. 1. Growth of articles, authors, and institutions during SCOAP3 (2014-2019) in South Korea. SCOAP3, Sponsoring Consortium for Open Access Publishing in Particle Physics.

Table 3. Growth of articles published in each group of journals

Journals	Number of articles		Increase	<i>p</i> -value of regression coefficient	
	2009-2013	2014-2018			
SCOAP3 journal group	A	2,033	4,203	2.07x	0.0006
	B	1,521	2,494	1.64x	0.0011
	C	1,801	2,111	1.17x	0.1782
Non-SCOAP3	216,369	363,780	1.68x	0.0001	

SCOAP3, Sponsoring Consortium for Open Access Publishing in Particle Physics.

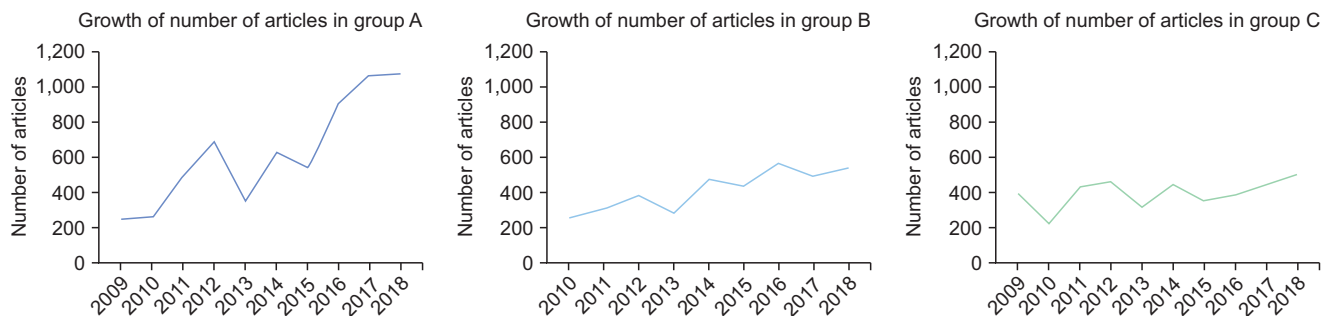


Fig. 2. Growth of articles published in three journal groups.

SCOAP3 were published, and C group includes journals where less than 10% of articles are supported by SCOAP3. Non-SCOAP3 journals where the articles are classified as “high energy physics, HEP, particle physics” in the NTIS database are published, but are not supported by SCOAP3 at all.

The number of articles in all groups increases, including non-SCOAP3. The articles published in Group A are significantly increased compared to the others, and compared to non-SCOAP3 journals as shown in Table 3 and Fig. 2. The result reflects the assumption that fully supported journals are preferred by researchers as their publishing venue rather than the journals that are supported inconsistently.

3.3.2. Financial Benefit of SCOAP3-Korea

Two different investments with different costs and different levels of effectiveness are considered for SCOAP3-Korea, enabling comparisons among potential strategies. As SCOAP3 converts the subscription fees invested for readers to the publication fees invested for authors (and readers), two different costs have been analyzed. The cost for subscribing to eight journals by 136 domestic institutions through the KESLI consortium is borrowed from the subscription fees in 2013. The subscription fees in 2017 for three APS journals is also considered as they joined in 2018. We estimated the cost conservatively; no inflation rate per year was considered, and the subscription fees paid from other approaches such as “paying without consortium discount,” “paying-per-view,” and other forms of paying outside the consortium were not taken into account. With regard to the investment for readers, the estimated cost is \$1,023,110 USD, but \$886,016 USD is paid as the national target contribution during Phase 1 and 2, saving \$137,094 USD. With regard to the cost for Open

Access publishing, the national share of 1,911 articles was calculated and multiplied by the average investment per article. The average investment per article is 1,100 Euros as indicated by SCOAP3 global, which is much lower than the average Article Processing Charge (APC) registered in the ESAC database.⁹ Again, we estimated the total cost for the national publication fees on behalf of Korean researchers conservatively. Without SCOAP3, Korean researchers would have paid the nominal APC (without any discount rate). The total cost saved during the two SCOAP3 phases with regard to publication fees is \$748,923 USD, as shown in Table 4.

4. DISCUSSIONS

4.1. Limitations

The purpose of this study is somehow ambitious because the study is designed according to the aims of the special issue of *JISTaP* for reviewing the history of the roles and responsibilities of KISTI and highlighting its outcomes. This study provides an overview of the roles and responsibilities of KISTI in the Open Access quest and the narrative of SCOAP3-Korea within this context. However, the outcomes of SCOAP3-Korea covered in Section 3.3 should be described more specifically. Cost estimation should be more rigorous, reflecting the reality, rather than conservative. In addition, so as to understand the benefit of SCOAP3-Korea thoroughly, the cost-effectiveness analysis should be performed from the perspective views. The analysis should be conducted also from a societal perspective, meaning all society as a whole regardless of who pays the costs, because the SCOAP3 project improves access to the scientific results of the whole population in society. Regarding the publication data for 2019, it has been re-adjusted to the one-year average because the publication

Table 4. Financial benefit with regards to subscription and publication

SCOAP3 phase	Estimated cost		Target contribution (C)	Cost saved (D)	
	Subscription (A)	APC (B)		(A-C)	(B-C)
Phase 1 (2014-16)	355,660	802,194	307,873	47,787	494,321
Phase 2 (2017-19)	667,450	832,745	578,143	89,307	254,602
Total sum	1,023,110	1,634,939	886,016	137,094	748,923

The monetary unit is US Dollars (USD). \$USD was chosen as the monetary unit for the analysis for the purpose of easy understanding of readers, although subscription fees were paid to publishers and the target contributions were transferred to CERN in Euros and US Dollars. SCOAP3, Sponsoring Consortium for Open Access Publishing in Particle Physics; APC, Article Processing Charge.

⁹<https://esac-initiative.org/about/transformational-agreements/agreement-registry/>

data are not of a full year. The one-year average number of publications in 2019 was used for the calculation of the amount of cost-saving in 2019.

4.2. Implications and Lessons from SCOAP3-Korea

SCOAP3 has established itself as a successful Open Access transition model. SCOAP3-Korea has shown its benefits to the research community in South Korea. There are several implications and lessons for the design of the expanded model for Open Access transition covering all disciplines, as SCOAP3 is not an end but the start point in the Open Access quest. Firstly, the robust and collective global partnership has demonstrated its control over costs, and sustained average article investments at a highly cost-effective. As OA2020 states, the global nature of research and publishing requires that the transformation should be a collaborative, global effort while embracing local practices and demands. Commitment to global Open Access initiatives, sharing resources and information, and actions aligned with the global communities will be decisive in the transition to Open Access at a larger scale. Secondly, the transformative contract should be as transparent as possible. For libraries to make an informed decision and share their resources and experience with other libraries, they need to keep the TA transparent and require publishers to keep the confidentiality clause at the minimum level. Thirdly, as most TA are made for converting a certain number of articles to Open Access in hybrid journals, monitoring what share of the journal is covered by each TA is necessary. Each TA made at each institution and country constitutes the entire share of Open Access articles in a journal, and the share of Open Access should be open to the public. A central registry is expected to be designed and managed by a central body such as CERN for SCOAP3 or Max Planck Digital Library for ESAC for monitoring the share of Open Access at the journal level and the package level. With the provision of integrated information, libraries and consortia can improve their ability to monitor all scholarly publication costs, including APCs and other costs, in order to gain a more complete view of the national and international publishing markets. Therefore, it is critical to establish and improve such monitoring mechanisms at institutional and national levels to assess the scale of spending on scholarly publications.

5. CONCLUSIONS

Over two decades, discussions on Open Access have been repeated globally with little progress. Recently, how-

ever, the interest in Open Access from various stakeholders and the pressure for implementing full and immediate Open Access from funders is growing dramatically. The motivation of Open Access has been well received by research communities in physics for a considerable time in South Korea, and Korean researchers have already published their articles in Open Access above the average among the G20. This article has illustrated how KISTI, as one of the leading Open Access advocates, has engaged in the collaborative and global effort and embraced local practices and preferences in South Korea over the last two decades. To set up a shared goal and establish practical strategies for Open Access transition at a large scale, this study examined the best practices of SCOAP3 and SCOAP3-Korea as its local variation, including its collaborative network and the financing model. In addition, the growth of the number of publications and authors and institutions involved in co-authorship was revealed. The positive impact in titles fully supported by SCOAP3 in increasing research publication in the HEP field was revealed compared to non-SCOAP3 journals. The financial benefit of SCOAP3-Korea has been proven. With regard to the investment for readers, \$137,094 USD was saved during the SCOAP3 Phase 1 and 2, while \$748,923 USD was saved with regard to publication fees. In this study, we estimated the cost too conservatively. It did not reflect the perspective of society as a whole where SCOAP3 and SCOAP3-Korea enhance the accessibility and the productivity of scientific outcomes for the public good. This further analysis will be conducted as our next study.

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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