# Development of an Index to Search a High Performance Researcher Considering Main Author

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## 1. Introduction

Hirsch(2005)[1] came up with the *h*-index, a very simple but at the same time rigorous measurement index that can measure the number of papers, which represents the productivity of researchers, and the number of citations, which represents the influence of a researcher. Later on, Egghe(2006)[2] developed and presented the *g*-index by applying *h*-index to analysis. Neither the *h*-index nor the *g*-index considered the contribution of the authors who appeared in individual papers, which were the subjects for evaluating the performance of researchers. That is, the roles of the main author, meaning the 1st author and correspondence author, and the co-authors, meaning all other authors, are the subjects for measurement of the performance of researchers, but they were not considered. For example, the number of citations, with which the influence of a certain paper can be measured, can be regarded as a cooperation of all authors who participated in the paper. However, as the roles contributed by each author in preparing the paper can be different, it is difficult to imagine that the 1st author, the correspondence author, and the co-authors all contributed to the same research performance. Therefore, it would be easier if an index that can measure the research performance depending on the role of each author can be used, and the purpose of this study is to develop an index to search for a high-performance researcher by considering only the main author of each paper.

## 2. Research Method and Data Collection

This study is based on data from 2 Korean researchers included in the Web of Science SCIE (Science Citation Index Expanded) and data from virtual authors with similar productivity and influence as the 2 researchers. In this study, dices such as the number of papers by each researcher, the number of citations, the average number of citations in one paper, the *h*-index, and the *g*-index were investigated from 3 aspects: the main author, the co-author and all authors. We investigated which way is more effective in order to identify the highest performance researcher out of all of the authors with similar research productivities and influence in the same research field. To carry out this study, 2 researchers in similar research fields were selected from the Web of Science SCIE out of the winners of the Knowledge Creation Award given by the Ministry of Education, Science and Technology (now the Ministry of Science, ICT and Future Planning) to collect the data required for the analysis. A virtual researcher's data, with a productivity and influence similar to that of the 2 researchers, were generated. The search formula, search result, and virtual data used in the Web of Science SCIE are shown in <Table 1>.

[Table 1] Web of Science Search Formula & Result

| Item | Search Formula | No. of Papers | No. of Authors | |
|---|---|---|---|---|
| | | | Total | Avg. |
| Researcher A | **Author Identifiers:** (B-****-2009)<br>**Refined by: DOCUMENT TYPES:** (ARTICLE)<br>*Timespan=1986~2014* | 210 | 1,021 | 4.9 |
| Researcher B | **Author Identifiers:** (J-****-2012)<br>**Refined by: DOCUMENT TYPES:** (ARTICLE)<br>*Timespan=1986~2014* | 181 | 1,340 | 7.4 |
| Researcher C | **Imaginary Data** | 167 | 1,037 | 6.2 |

## 3. Results

First, the number of papers out of all of the papers and the number of citations were as follows: It was found that the research productivity, that is, the number of papers that were excellent in the order of Researcher A(210 papers), B(181 papers), and C(167 papers), and that the research influence, that is, the number of citations, were excellent in the order of Researcher B(20,032 times), A(17,848 times), and C(17,692 times). When the average number of citations was studied, Researcher B(110.7 times), C(105.9 times), and A(85.0 times), showed that the influence of A was the highest, but the virtual researcher C was found to have a higher influence than A. The analysis result of papers whose researchers participated as the main author is like follows: The number of papers was excellent in the

order of Researcher A(83 papers, 39.5%), B(82 papers, 45.3%), and C(54 papers, 32.3%), showing the same result as the result of the total paper analysis. However, even though the average number of citations was excellent in the order of B(160.9 times), C(154.5 times), and A(136.5 times), which was the same as the result of all of the paper analysis result, the number of citations for papers in which the researcher participated as the main author was found to be excellent in the order of B(13,190 times, 65.8%), A(11,330 times, 63.5%), and C(8,343 times, 47.2%), showing the same ranking as the analysis result of all the papers.

[Table 2] Comparison of productivity and influence between 3 researchers

| Item | No. of Papers | | | No. of Citations | | | Avg. No. of Citations | | |
|---|---|---|---|---|---|---|---|---|---|
| | main author | co-author | total | main author | co-author | total | main author | co-author | total |
| Researcher A | 83(39.5%) | 127 | 210 | 11,330(63.5%) | 6,518 | 17,848 | 136.5 | 51.3 | 85.0 |
| Researcher B | 82(45.3%) | 99 | 181 | 13,190(65.8%) | 6,842 | 20,032 | 160.9 | 69.1 | 110.7 |
| Researcher C | 54(32.3%) | 113 | 167 | 8,343(47.2%) | 9,349 | 17,692 | 154.5 | 82.7 | 105.9 |

Next, the *h*-index and *g*-index that measure the paper productivity and influence of an author simultaneously were like follows: the *h*-index was high for Researcher B and C (74 each), followed by A (67), while the *g*-index was high in the order of researcher B (140), C (132), and A (131), showing a very similar result as the analysis result of average number of citations. However, the analysis result considering only the papers in which the research participated as the main author is like follows: the *h*-index was high in the order of researcher B (57), A (46), and C (40), showing that A had higher productivity and influence than C, which is different from the analysis result of all the papers. However, even though the average number of citations was high in the order of B (160.9 times), C (160.2 times), and A (136.5 times), which was the same as the analysis result of total papers, the number of citation of papers in which the researcher participated as the main author was high in the order of B (13,190 times, 65.8%), A (11,330 times, 63.5%), and C (8,650times, 48.1%). Thus, B showed the same ranking as the analysis result of all the papers, while the rankings of A and C were reversed. That is, even though C had a higher average number of citations, as the number of papers by A was exceptionally high, the number of citations of A was higher.

[Table 3] Comparison of *h*-index and *g*-index between 3 researchers

| Item | *h*-index | | | *g*-index | | |
|---|---|---|---|---|---|---|
| | main author ($h_m$-index) | co-author | total | main author ($g_m$-index) | co-author | total |
| Researcher A | 46 | 40 | 67 | 83 | 79 | 131 |
| Researcher B | 57 | 44 | 74 | 82 | 82 | 140 |
| Researcher C | 40 | 55 | 74 | 54 | 95 | 131 |

## 4. Discussion

In the result of the study, while the number of papers by each research out of all the papers and the number of citations didn't show a change in the ranking that depends on whether the researcher was the main author, the rankings of the *h*-index and *g*-index showed different rankings depending on whether the research was by the main author. Accordingly, a necessity to consider whether the research had the main author as a factor to develop an index that can measure the productivity and influence of a researcher was suggested. In the future, it is required to consider that the number of citations is influenced by the number of co-authors in carrying out a research on the development of a measurement index of researcher performance.

## 5. References

[1] J.E. Hirsch, 2005, "An Index to quantify an individual's scientific research output", Proceedings of the National Academy of Sciences of the United States of America, 102(46), pp. 16569-16572. doi:10.1073/pnas.0507655102.
[2] L. Egghe, 2006, "Theory and practise of the g-index", Scientometrics, 69(1), pp. 131–152. doi:10.1007/s11192-006-0144-7