ORIGINAL ARTICLE

Ranking of the scientific units of Polish physical education high schools based on citations from Web of Science for the period of 2009-2012 indexed by the Polish Ministry of Science and Higher Education – focus on specialists in science of martial arts

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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Abstract

Background & Study Aim: Citation is a single parametric way of measuring popularity of an individual and productivity of institutions, undoubtedly the most popular in the scientific world. Imperfection of this indicator is reflected by it being manipulated by the authors, research groups, editors or publishers. In spite of this weakness, the citation still remains the key driver for measurement of personal scientific achievements, evaluation of scientific institutions, a tool driving state scientific policy. The aim of this article is the ranking of academics working in Polish physical education high schools based on the citations reported for the national evaluation for the years 2009-2012 (with focus on specialists in the science of martial arts).

Material & Methods: Data about 25 units (the same ones as in the previous articles) were used in the study. One unit whose academics did not have any citation in years 2009-2012 was excluded from the analysis. The citations were reported by 24 scientific units (faculties) of Polish physical education high schools and related units (providing education in i.a. physiotherapy, recreation and sport). Citations, on which the analysis was based, were provided independently by the scientific units which had applied for the scientific category to list the number of publications cited in years 2009-2012 in accordance with Web of Science, i.e. to provide the number of publications cited in years 2009, 2010, 2011 and 2012 written by any scientific or research-didactic employee and covering all scientific achievements. The analysis was based on citations of these academics who had at least one citation in observed period, with focus on citations made by scientific representatives of the science of martial arts. They were selected on the basis of their qualifications of martial arts (black belt or coaching qualifications) or master class (boxing, fencing, self-defence, unifight, wrestling, etc.).

Results: In the period 2009-2012 analysed institutions reported 5,929 citations; 4,811 (81%) were confirmed by academies of physical education, whereas 1,118 (19%) by academics of seven other types of institutions (technical universities, universities, other types of high schools). One unit out of 17 faculties of physical education academies generated 1/6 (n=996) of all citations.

Among 1,604 academics from 24 scientific units, only 365 (23%) persons had citations in the Web of Science. In 4 institutions, less than 10% (n=15) academics had citations; in 8 units 10-20% (n=72); in 7 institutions 20-30% (n=157); in 4 units 30-40% (n=105); and in only 1 institution, almost 50% of academics had citations. The Spearman's rank correlation shows the strong correlation among cumulative Impact Factor and citations. The representatives of the science of martial arts (n=24) had significant impact. This group constitutes 1,5% of the PE academics population, whose productivity delivered 6.8% (n=403) of all citations.

Conclusions: Modern instruments of national science policy has far beyond involved a single-parameter evaluation, which is still the method frequently used to analyse individuals or institutions. The framework of the national evaluation of the scientific potential involves the number of parameters (generally identified as: scientific and creative achievements, scientific potential, material effects of the scientific activity, other effects of scientific activity) where citations are complements evaluation of the scientific institutions bringing the science or research development to the highest level. Evaluation model, parameters and criteria, changes in the law (reforms), involvement of scientists (Committee for Evaluation of Scientific Units), information system collecting the data on higher education and science (POL-on), peer review of collected data, presentation of results, feedback and further improvements (new regulation of the Polish Ministry of Science and Higher Education from 27 October 2015 on the criteria and procedure for assigning scientific categories to scientific units) prove the excellent science policy in Poland achieved through comprehensive assessment of scientific units to accelerate research and facilitate innovation. On this background, Polish academics dealing with the science of martial arts are recognized in global science as top specialists with the leadership of the units of Polish physical education high schools (Kraków, Gdańsk, Wrocław).

Key words: Academy of Physical Education · citation · evaluation · physical education · POL-on · scientific achievement · scientific policy · sports science

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Academic – a person who is a teacher and/or conducts research in a high school i.e. academy of physical education, technical university, university.

Academy of Physical Education – an institution of university type providing education in the field of sport science, having full academic rights (from bachelor to a professor with the right to confer a "*doctor honoris causa*" title). In Poland, there are six academies of physical education: the Academy of Physical Education in Katowice, Krakow, Poznan, Warsaw, Wroclaw and the Academy of Physical Education and Sport in Gdansk.

Evaluation – a process of examining parameters applied to methodology.

Faculty – is a unit within a high school which deals with one subject area or a number of related subject areas i.e. health promotion, physical education, physiotherapy, rehabilitation, sport, tourism and recreation.

Polish physical education high schools – in the article, this is the operational term for the Academies of Physical Education and related public or non-public higher schools, that provided education on at least one of the units related to sport science (physical education, physiotherapy, recreation, sport).

POL-on – the comprehensive information system to collect data on higher education and science.

Publications – reviewed articles published in scientific journals.

Introduction

Citation is a single parametric way to measure popularity of an individual and productivity of institutions, which is undoubtedly most common in the scientific world [1-2]. Imperfection of this indicator is reflected by it being manipulated by the authors, research groups, editors or publishers [3-7]. In spite of this weakness, the citations still remain the key driver for measurement of personal scientific achievements, evaluation of scientific institutions, a tool driving state scientific policy [8-10]. The first reason is the universality of this indicator. The second reason is the time and availability of information (although dependent on expensive annual licenses). The third one is a trend to facilitate the reporting and periodic assessments.

Library or Information Science Department of a typical Polish scientific institution collects information that are of bibliographic nature. Bibliographic databases provide quantitative information on scientific achievements or publications produced by individual scientists and institutions, but do not provide data on any other scientific activities going on at various scientific institutions, for example research programs, clinical trials, technology transfer, intellectual property development, etc.

In contrast, the prime example is *POL-on* [11], the comprehensive nationwide information system collecting the data on higher education and science, initiated in 2011 within the operational programme "Human Capital" financed from the European Social Fund, and constantly developing towards spreading information on the effects of financing science, but also serving as a key instrument of national science policy.

Part of the *POL-on* is the *POL-index*, which is Polish citations base, launched in 2015 to gather information about publications published in the years 2009-2014, which will allow (for the first time) to calculate the *Polish Impact Factor* (org. *Polski Współczynnik Wpływu*) in 2017 for the Polish nationwide evaluation of scientific units[1] [12].

Taking into account the fact that the *POL-index* is planned as an important element in the next assessment of Polish science and higher education, it will become an important contribution and complement to the previous two articles (*Ranking of Polish physical education high schools based on the articles published in 2009-2012 indexed by the Polish Ministry of Science and Higher Education* [13] and *The first ranking of the scientific units of Polish physical education high schools based on the monographs published in 2009-2012 indexed by the Polish Ministry of Science and Higher Education* [14]) to obtain the citations input of Polish academics of the sports science.

The aim of this article is the ranking of academics employed in Polish physical education high schools based on the citations reported for the national evaluation for the years 2009-2012 with focus on specialists in the *science of martial arts*.

1. The evaluation covered 963 institutions (higher education institutions, the Polish Academy of Science, scientific institutes, and other scientific units) applying for subsidies from the governmental budget. Each unit was assigned to one of 4 scientific fields (social & humanistic, science & technology, life science, art) differentiating some of the parameters and metrics. Within 9 months in 2013, the Polish Ministry of Science and Higher Education collected data from scientific institutions concerning years 2009-2012 and with support of the Committee for Evaluation of Scientific Units classified them to 60 groups with common assessment. They were assessed by 160 experts, who compared them pair wise and categorised into category A, B or C. Within the best category (A) the best of the best units were selected and granted category A+ [14].

Material and methods

Data about 25 units were used in the study. Selection of scientific units was analogical to the analysis of publications described in the previous articles [13, 14]. One unit whose academics did not have any citation in years 2009-2012 was excluded from the analysis. The citations were reported by 24 scientific units (faculties) of Polish physical education high schools and related units (providing education in i.e. physiotherapy, recreation, sport). Citations, on which the analysis was based, were provided independently by the scientific units which applied for the scientific category to list the number of publications cited in years 2009-2012 in accordance with *Web of Science*, i.e. to provide the number of publications cited in years 2009, 2010, 2011 and 2012 written by any scientific or research-didactic employee and covering all scientific achievements. The analysis was based on citations of these academics who had at least one citation in observed period, with focus on citations of the scientific representatives of the *science of martial arts*, selected based on their qualifications related to martial arts (black belt or coaching qualifications) or master class (boxing, fencing, self-defence, unifight, wrestling, etc.).

Statistical analysis based on the quartiles, cumulative calculating and data aggregated into ranks has been used in the study. Results were saved in a database designed for this purpose in Microsoft Excel 2013. The Spearman's rank correlation identifies the strength of correlation among citations and publications. The source data was reported by institutions to the *POL-on* system for the purposes of parametric evaluation of scientific units provided by the Polish Ministry of Science and Higher Education. In order to simplify the analysis, single employment of academics has been taken into account, indicating the unit to which the citations were reported. In the analysis of specialists in the science of martial arts, the Hirsch scores were collected directly from the *Web of Science Core Collection* accessed in the academic library.

Due to the specificity of the research issues, the chapter „Results" is not solely the collection of perceptual sentences (as well as tables and accompanying figures). It also includes conclusions, commentaries and explanations.

Results

In the period 2009-2012, analysed institutions reported 5,929 citations in total; 4,811 (81%) were confirmed by academies of physical education, whereas 1,118 (19%) by academics of seven other types of institutions (technical universities, universities, other types of high schools). *Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego* generated a 1/6 (n=996) of all citations (Table 1) of the 17 faculties of physical education academies. The other leading units with over >500 citations in studied period were: *Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Rehabilitacji Ruchowej* (n=722), *Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Wychowania Fizycznego* (n=523), *Akademia Wychowania Fizycznego we Wrocławiu; Wydział Fizjoterapii* (n=510).

Among 1,604 academics employed in 24 scientific units, only 365 (23%) persons had citations in the Web of Science (Table 1, the criterion "number of employees cited"). In 4 institutions less than 10% (n=15) academics had citations; in 8 units - 10-20% (n=72); in 7 institutions - 20-30% (n=157); in 4 units - 30-40% (n=105); and only in *Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii* almost 50% of academics had a citations.

These findings show that faculties in a four-year assessment period of its academics' efforts have been concentrated on limited promotion of own scientific potential and achievements. Accidental high number of citations result from: individual efforts, the reputation of particular researchers, creativity, scholarly collaboration or scientific activity which goes beyond sports science.

On this background, population of 24 specialists in the *science of martial arts* from 10 units has been analysed, however only 19 academics from 9 faculties had citations in the *Web of Science* therefore, in accordance with the methodology adopted, only those data were subject to analysis (Table 2).

The representatives of the *science of martial arts* had a significant impact. This group constituted 5.2% of the PE academics population with evidenced citations, whose productivity delivered 6.8% (n=403) of all citations.

The specialists in the *science of martial arts* were identified in the data evidenced by scientific units, hence lack of some persons is either the result of accuracy in reported data and regulations concerning qualifications of employee or employment in other institutions out of the analysed population.

Ranking – a classification of performance arranged in a descending order.

Units – scientific units that continuously engage in research or development work:
a) basic organisational units of higher education institutions within the meaning of the Charters of these higher education institutions;
b) scientific units of the Polish Academy of Sciences within the meaning of the Act of 30 April 2010 on the Polish Academy of Sciences (Polish Journal of Laws [Dz. U.] No 96/2010, Item 619);
c) research institutes;
d) international scientific institutes established pursuant to separate regulations, operating in the territory of the Republic of Poland;
e) the Polish Academy of Arts and Sciences;
f) other organisational units not listed in *a)* to *e)*, which have legal personality and have registered offices in the Republic of Poland, including entrepreneurs with a status of a research and development centre granted pursuant to the Act of 30 May 2008 on Certain Forms of Support for Innovative Activities (Polish Journal of Laws [Dz. U.] No 116/2008, Item 730 and No 75/2010, Item 473) [22].

Table 1. Ranking of scientific units of Polish physical education high schools on the basis of the number of publications cited in years 2009-2012 (the criterion of order is "total citations").

Ranking position	High schools (n=24)	Total citations	Number of all employees	Number of employees cited
1	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	**996**	89	25
2	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Rehabilitacji Ruchowej	**722**	60	21
3	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Wychowania Fizycznego	**523**	92	31
4	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Fizjoterapii	**510**	86	34
5	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	**479**	97	26
6	Wyższa Szkoła Informatyki i Zarządzania w Rzeszowie; Wydział Turystyki i Nauk o Zdrowiu	**434**	71	12
7	Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii	**387**	98	20
8	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Wydział Wychowania Fizycznego, Sportu i Rehabilitacji	**350**	143	38
9	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podlaskiej	**210**	73	21
10	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Wychowania Fizycznego	**187**	92	18
11	Uniwersytet Szczeciński; Wydział Kultury Fizycznej i Promocji Zdrowia	**185**	50	9
12	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Zamiejscowy Wydział Kultury Fizycznej w Gorzowie Wielkopolskim	**165**	57	19
13	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Rehabilitacji	**159**	61	16
14	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego	**149**	126	18
15	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii	**140**	34	16
16	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	**138**	44	11
17	Uniwersytet Technologiczno-Humanistyczny im. Kazimierza Pułaskiego w Radomiu; Wydział Nauk o Zdrowiu i Kultury Fizycznej	**47**	31	4
18	Wyższa Szkoła Zarządzania i Administracji w Zamościu; Wydział Fizjoterapii i Pedagogiki	**37**	27	3
19	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Turystyki i Rekreacji	**34**	40	4
20	Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego	**25**	104	7
21	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Turystyki i Rekreacji	**21**	27	4
22	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Turystyki i Rekreacji	**21**	41	3
23	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Wydział Turystyki i Rekreacji	**7**	49	3
24	Uniwersytet Kazimierza Wielkiego w Bydgoszczy; Wydział Kultury Fizycznej, Zdrowia i Turystyki	**3**	51	2

Table 2. Ranking of scientific units of Polish physical education high schools with focus on specialists in the *science of martial arts*, based on the number of publications cited in years 2009-2012 (the criterion of order is "total citations").

Ranking position	Higher schools (n=10)	Total citations	Number of cited specialists in science of martial arts	Number of all specialists in science of martial arts
1	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	**218**	5	5
2	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Wychowania Fizycznego	**72**	1	1
3	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	**61**	5	5
4	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	**18**	3	3
5	Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii	**14**	1	1
6	Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego	**10**	1	2
7	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii	**5**	1	1
8	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego	**3**	1	3
9	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podlaskiej	**2**	1	1

The most productive authors who qualified to 75% quartile in descending order were: Sterkowicz Stanisław, Langfort Józef, Kalina Roman Maciej, Jagiełło Władysław, Laskowski Radosław (Table 3). This resembles Peset F et al. [15] who analysed publications from 2001-2010 where: Sterkowicz Stanisław and Jagiełło Władysław belonged to the most productive authors of the *science of martial arts*.

Due to the exclusion criteria, the following specialists in the science of martial arts (despite their presence) were not included in the analysis: Bąk Robert, Kużmicki Stanisław, Łuczak Maciej, Nowak Tomasz, Sokołowski Marek.

While comparing the citations in analysed period, the following dynamics was revealed: in 19 units an increase in citations was observed, in 1 unit the number of citations remained at a similar level, while in 4 it decreased (Table 4). The highest dynamics of citations reported in 2009-2012 was noted at: *Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Wydział Wychowania Fizycznego, Sportu i Rehabilitacji* (146.7%), *Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii* (143.3%). The dynamics in 5 faculties was >50% and in 12 <50%. The negative trend was observed at: *Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii* (—1.6%), *Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podlaskiej* (—15.8%), *Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego* (—17.8%), *Uniwersytet Kazimierza Wielkiego w Bydgoszczy; Wydział Kultury Fizycznej, Zdrowia i Turystyki* (—100%). Minus sign („—") indicates a negative value of dynamic.

The ranking of scientific units of Polish physical education high schools based on scientific articles published in 2009-2012 in journals indexed in *Journal Citation Reports* has been compared with the ranking developed on the basis of publications cited in the years 2009-2012 (Table 5) by calculating the Spearman correlation. It revealed strong correlation equal to 0.817. A detailed analysis of this correlation showed a regular growth of the cumulative *Impact Factor* parallel to the number of publications cited in the years 2009-2012. This observation is confirmed by the dynamics of the number of citations, which rises from 887 in 2009 in relation to the previous year to 47% (1,306) in 2010, 26% (1,642) in 2011 and 28% (2,094) in 2012 (Table 4).

Based on the Table 5, the matrix of ranking positions of the scientific units of Polish physical education higher schools was obtained and based on cumulative number of citations and cumulative *Impact Factor* in the years 2009-2012 (Figure 1). At this time 2 units turned out to be the most productive (cf. the green field between axis '*Influence*' and '*Productivity*'): *Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Rehabilitacji Ruchowej* and *Akademia Wychowania Fizycznego we Wrocławiu; Wydział Fizjoterapii*. These results prove that the faculties specific for academies of physical education generate the highest scores, which has a direct impact on spreading these achievements world-wide. As for

Table 3. Most productive Polish specialists in the science of martial arts on the basis of the number of publications cited in the years 2009-2012 (the criterion of order is a sum of citations in all years).

Ranking position	Specialist of the science of martial	Higher schools (n=10)	Total citations 2009	Total citations 2010	Total citations 2011	Total citations 2012
1	Sterkowicz Stanisław	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	22	36	60	61
2	Langfort Józef	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Wychowania Fizycznego	13	20	21	18
3	Kalina Roman Maciej	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii	–/4*	0/9*	2/15*	3/16*
4	Jagiełło Władysław	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	3	8	11	8
5	Laskowski Radosław	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	1	2	6	11
6	Sterkowicz-Przybycień Katarzyna	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	0	0	8	11
7	Błach Wiesław	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	6	3	4	3
8	Lech Grzegorz	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu			9	7
9	Borysiuk Zbigniew	Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii	4	4	3	3
10	Cynarski Wojciech	Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego	1	2	3	4
11	Suchanowski Andrzej	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	0	2	0	4
12	Kłys Artur	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu				3
13	Kruszewski Artur	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego	0	1	2	
14	Wolska-Paczoska Beata	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	0	1	1	1
15	Gierczuk Dariusz	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podlaskiej	0	1	0	1
16	Smaruj Mirosław	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	1	1	0	0
17	Chwała Wiesław	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	0	0	0	1
18	Maślinski Jarosław	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	0	0	0	1
19	Stefaniak Tadeusz	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	0	0	0	1

* Faculty made a mistake demonstrating the number of publications (left value) instead of the number of citations (right value). It was caused by change of employment, inaccurate register of achievements and inappropriate qualification of citations by the unit.

Table 4. The dynamics of citations among scientific units of Polish physical education high schools based on the number of publications cited in the years 2009-2012 (the criterion of order is a sum of citations in all years).

Ranking position	High schools (n=24)	Total citations 2009	Total citations 2010	Total citations 2011	Total citations 2012
1	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	196	209	268	323
2	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Rehabilitacji Ruchowej	86	168	189	279
3	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Wychowania Fizycznego	84	116	184	139
4	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Fizjoterapii	64	142	157	147
5	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	39	107	153	180
6	Wyższa Szkoła Informatyki i Zarządzania w Rzeszowie; Wydział Turystyki i Nauk o Zdrowiu	57	84	103	190
7	Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii	86	119	100	82
8	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Wydział Wychowania Fizycznego, Sportu i Rehabilitacji	12	58	102	178
9	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podlaskiej	67	62	41	40
10	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Wychowania Fizycznego	38	42	54	53
11	Uniwersytet Szczeciński; Wydział Kultury Fizycznej i Promocji Zdrowia	32	31	48	74
12	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Zamiejscowy Wydział Kultury Fizycznej w Gorzowie Wielkopolskim	13	38	30	84
13	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Rehabilitacji	18	28	54	59
14	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego	22	23	46	58
15	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii	5	25	38	72
16	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	32	23	32	51
17	Uniwersytet Technologiczno-Humanistyczny im. Kazimierza Pułaskiego w Radomiu; Wydział Nauk o Zdrowiu i Kultury Fizycznej	8	7	9	23
18	Wyższa Szkoła Zarządzania i Administracji w Zamościu; Wydział Fizjoterapii i Pedagogiki	10	8	9	10
19	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Turystyki i Rekreacji	4	3	3	24
20	Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego	9	7	4	5
21	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Turystyki i Rekreacji	4	3	8	6
22	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Turystyki i Rekreacji			8	13
23	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Wydział Turystyki i Rekreacji	0	1	2	4
24	Uniwersytet Kazimierza Wielkiego w Bydgoszczy; Wydział Kultury Fizycznej, Zdrowia i Turystyki	1	2	0	0

Table 5. Ranking of Polish physical education high schools based on the number of publications cited in the years 2009-2012 and cumulative *Impact Factor* from 2009-2012 (the criterion of order is "total citations").

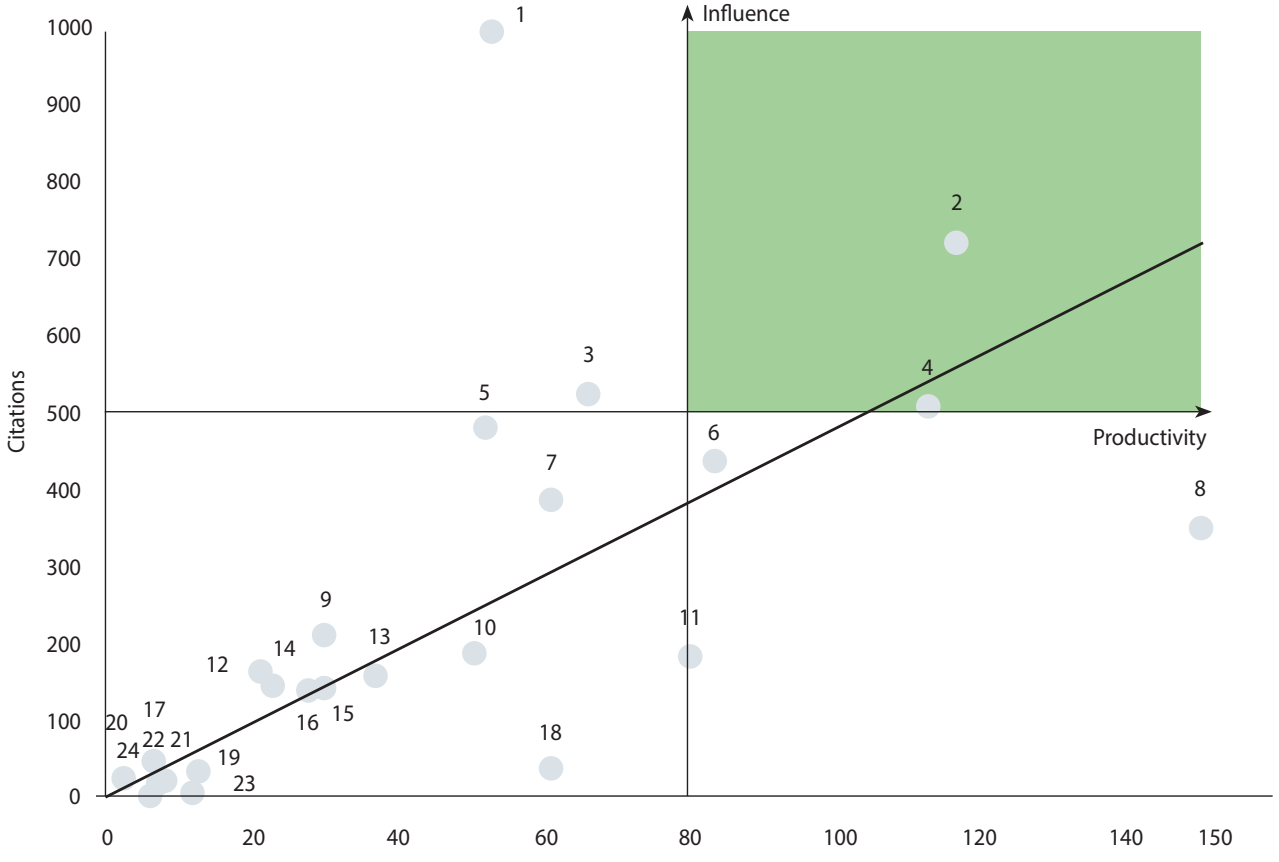
Ranking position	Higher schools (n=24)	Total IF points	Number of articles with IF	Total citations
1	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	52.985	29	**996**
2	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Rehabilitacji Ruchowej	116.817	58	**722**
3	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Wychowania Fizycznego	65.994	46	**523**
4	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Fizjoterapii	112.845	61	**510**
5	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	52.122	50	**479**
6	Wyższa Szkoła Informatyki i Zarządzania w Rzeszowie; Wydział Turystyki i Nauk o Zdrowiu	83.336	33	**434**
7	Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii	60.950	31	**387**
8	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Wydział Wychowania Fizycznego, Sportu i Rehabilitacji	150.265	88	**350**
9	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podlaskiej	29.998	28	**210**
10	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Wychowania Fizycznego	50.640	42	**187**
11	Uniwersytet Szczeciński; Wydział Kultury Fizycznej i Promocji Zdrowia	80.226	50	**185**
12	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Zamiejscowy Wydział Kultury Fizycznej w Gorzowie Wielkopolskim	20.819	18	**165**
13	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Rehabilitacji	37.018	25	**159**
14	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego	22.480	33	**149**
15	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii	29.901	30	**140**
16	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	27.671	22	**138**
17	Uniwersytet Technologiczno-Humanistyczny im. Kazimierza Pułaskiego w Radomiu; Wydział Nauk o Zdrowiu i Kultury Fizycznej	6.528	9	**47**
18	Wyższa Szkoła Zarządzania i Administracji w Zamościu; Wydział Fizjoterapii i Pedagogiki	60.986	6	**37**
19	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Turystyki i Rekreacji	12.609	14	**34**
20	Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego	2.173	4	**25**
21	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Turystyki i Rekreacji	7.988	6	**21**
22	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Turystyki i Rekreacji	7.014	5	**21**
23	Akademia Wychowania Fizycznego im. Eugeniusza Piaseckiego w Poznaniu; Wydział Turystyki i Rekreacji	11.847	10	**7**
24	Uniwersytet Kazimierza Wielkiego w Bydgoszczy; Wydział Kultury Fizycznej, Zdrowia i Turystyki	5.810	5	**3**

other units, this area should be a priority if they wish to achieve the goals set in the way of scientific development. Such action would be complicated because it requires mobilization of human resources, involvement of assets, stimulated creativity and modern scientific policy supporting the comprehensive management system for institution performance and evaluation of academics achievements, i.e. *ScienceWizard*[2] (4 Medicine Rek LLP, Warsaw, Poland; visit http://sciencewizard.pl), which is a web-based interactive science management tool to support the enhancement of productivity, innovation and competitiveness according to institution´s strategies, goals and challenges. *ScienceWizard* allows managers to select the best resources according to the institution´s priorities, make the correct decisions at the right time and get new initiatives on the road towards the Excellence in science.

Discussion

The uniqueness of the presented rankings is based on the faculties individually subject to the assessment (not the entire institutions), which allowed for precise evaluation of researches, units productivity and impact on the spread of achievements.

2. The system meets characteristics of an innovation found to influence and productivity adoption include relative advantage, compatibility, complexity, trialability and observability.



1 AWFiS w Gdańsku; Wydział Wychowania Fizycznego
2 AWF w Krakowie; Wydział Rehabilitacji Ruchowej
3 AWF w Katowicach; Wydział Wychowania Fizycznego
4 AWF we Wrocławiu; Wydział Fizjoterapii
5 AWF w Krakowie; Wydział Wychowania Fizycznego i Sportu
6 WSIiZ w Rzeszowie; Wydział Turystyki i Nauk o Zdrowiu
7 Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii
8 AWF w Poznaniu; Wydział Wychowania Fizycznego, Sportu i Rehabilitacji
9 AWF w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podl.
10 AWF we Wrocławiu; Wydział Wychowania Fizycznego
11 Uniwersytet Szczeciński; Wydział Kultury Fizycznej i Promocji Zdrowia
12 AWF w Poznaniu; Zamiejscowy Wydział Kultury Fizycznej w Gorz Wlkp.
13 AWF w Warszawie; Wydział Rehabilitacji
14 AWF w Warszawie; Wydział Wychowania Fizycznego
15 AWF w Katowicach; Wydział Fizjoterapii
16 AWF we Wrocławiu; Wydział Nauk o Sporcie
17 Uniwersytet Tech-Hum w Radomiu; Wydział Nauk o Zdrowiu i Kultury Fiz.
18 WSZiA w Zamoś ciu; Wydział Fizjoterapii i Pedagogiki
19 AWFiS w Gdańsku; Wydział Turystyki i Rekreacji
20 Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego
21 AWF w Krakowie; Wydział Turystyki i Rekreacji
22 AWF w Warszawie; Wydział Turystyki i Rekreacji
23 AWF w Poznaniu; Wydział Turystyki i Rekreacji
24 Uniwersytet Kazimierza Wielkiego w Bydgoszczy; Wydział Kultury Fiz.

Figure 1. Matrix of ranking positions of the scientific units of Polish physical education high schools based on the cumulative number of citations and cumulative *Impact Factor* (Table 5) in years the 2009-2012.

Notwithstanding of the simplicity of the methodology, an assessment of Polish high schools of physical education measured on the basis of the number of publications cited allowed to precisely and accurately classify the faculties.

The research results presented in the article show that Polish higher schools of physical education spread the knowledge only in narrow range. The ratio of citations is related to the *Pareto principle*, which states that for many events roughly 80% of the effects come from 20% of the causes. Numbers 80 and 20 should not be regarded as the only right ones, as they most frequently appear in observations. Analysed data revealed that 23% of academics have been cited at least once in the years 2009-2012 covering all scientific achievements. Therefore, the claim that 77% of faculty productivity come from citations of 23% academics is justifiable.

Table 6. Ranking of Polish specialists in the science of martial arts on the basis of current *Hirsch* indicator (November 2015) and number of publications cited in the years 2009-2012 (the criterion of order is "Hirsch 2015").

Ranking position	Specialist of the science of martial	Higher schools (n=10)	Hirsch 2015	Total citations 2009-2012
1	Sterkowicz Stanisław [Prof.]	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	**12**	179
2	Langfort Józef [Prof.]	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Wychowania Fizycznego	**11**	72
3	Kalina Roman Maciej [Prof.]	Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach; Wydział Fizjoterapii	**9**	44*
4	Jagiełło Władysław [Assoc. Prof.]	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	**8**	30
5	Laskowski Radosław [Assoc. Prof.]	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	**6**	20
6	Sterkowicz-Przybycień Katarzyna [Assoc. Prof.]	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	**5**	19
	Lech Grzegorz [Assoc. Prof.]	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	**5**	16
7	Chwała Wiesław [Ph.D.]	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	**4**	1
8	Błach Wiesław [Ph.D.]	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	**3**	16
	Borysiuk Zbigniew [Assoc. Prof.]	Politechnika Opolska; Wydział Wychowania Fizycznego i Fizjoterapii	**3**	14
	Cynarski Wojciech [Assoc. Prof.]	Uniwersytet Rzeszowski; Wydział Wychowania Fizycznego	**3**	10
	Smaruj Mirosław [Ph.D.]	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	**3**	2
9	Kłys Artur [MSc]	Akademia Wychowania Fizycznego im. Bronisława Czecha w Krakowie; Wydział Wychowania Fizycznego i Sportu	**2**	3
	Kruszewski Artur [Ph.D.]	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego	**2**	3
	Wolska-Paczoska Beata [Ph.D.]	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	**2**	3
	Gierczuk Dariusz [Ph.D.]	Akademia Wychowania Fizycznego Józefa Piłsudskiego w Warszawie; Wydział Wychowania Fizycznego i Sportu w Białej Podlaskiej	**2**	2
	Maślinski Jarosław [Ph.D.]	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	**2**	1
10	Suchanowski Andrzej [Assoc. Prof.]	Akademia Wychowania Fizycznego i Sportu im. Jędrzeja Śniadeckiego w Gdańsku; Wydział Wychowania Fizycznego	**1**	6
	Stefaniak Tadeusz [Assoc. Prof.]	Akademia Wychowania Fizycznego we Wrocławiu; Wydział Nauk o Sporcie	**1**	1

* see explanation to the Table 3

Figure 1 shows the citations and influence of *Impact Factor* as an effect of scientific activity and productivity of faculties analysed with the Spearman's rank correlation. An area in north-east quadrant (green field) is the most desirable place for the units because of the prestige, the ability to popularize the achievements, international scholarly collaboration with the greatest institutions, the availability of funding from public sources and competition on the market.

There are also important aspects concerning analysis of the specialist in the science of martial arts. To confirm the results presented in Table 3, current *Hirsch* indicator was used (Table 6). The comparison of the data provides the empirical proof that regardless of analysed period and type of indicator the top scientist in the science of martial arts occupy the same ranking position. The first three places are occupied by professors, who excellently fulfil their mission of education, promotion specialist of the science of martial arts, conducting cutting-edge research, developing the science of martial arts and sharing achievements in the international reputable journals, aimed to publish articles devoted to martial arts and combat sports i.e. *Archives of Budo*. Professors represent 16% (n=3), associate professors 42% (n=8), doctors of philosophy 37% (n=7) and masters of science 5% (n=1).

The research results presented in the article show that Polish high schools of physical education increase the number of cited publications, which probably results from the pressure put by the national scientific policy and impact of the "*publish or perish*" ideology. A low number of academics' citations was surprising which proves that although Polish sport science is under development, excellent policy and action research that contributes to sustainable development should become one of the key challenge.

Conclusions

Modern instruments of national science policy has far beyond involved a single-parameter evaluation, which is still the method frequently used to analyse individuals or institutions. The framework of the national evaluation of the scientific potential involves the number of parameters (generally identified as: scientific and creative achievements, scientific potential, material effects of the scientific activity, other effects of scientific activity) where citations are complements evaluation of the scientific institutions bringing the science or research development to the highest level. Evaluation model, parameters and criteria [16], changes in the law (reforms) [17], involvement of scientists (Committee for Evaluation of Scientific Units), information system collecting the data on higher education and science (POL-on), peer review of collected data, presentation of results, feedback [18-20] and further improvements (new regulation of the Polish Ministry of Science and Higher Education from 27 October 2015 on the criteria and procedure for assigning scientific categories to scientific units in reference to the Act of 30 April 2010 on the Principles of Financing Science with further changes) [21,22] prove the excellent science policy in Poland achieved through comprehensive assessment of scientific units to accelerate research and facilitate innovation. On this background, Polish academics dealing with the science of martial arts are recognized in global science as top specialists with the leadership of the units of Polish physical education high schools (Kraków, Gdańsk, Wrocław).

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Competing interests

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