EVALUATION OF RESEARCH IN A GREEK PEDAGOGICAL & TECHNOLOGICAL HIGHER EDUCATION INSTITUTION

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Abstract: *In Greece the evaluation of Higher Education Institutions (HEIs) is now obligatory in accordance with Law 3374/2005 following also the European initiatives for a European Higher Education Area. The criteria and the indices of the Greek evaluation methodology refer to four axes (pillars), one of which is the quality of the research work. Among the contemporary approaches which have been proposed for the assessment of the quality of research, bibliometric measures and indices are widely applied. In the present paper, the research output of all Academic Departments of the School of Pedagogical & Technological Education (ASPETE) is evaluated by using bibliometric indices such as the total and average publications and citations and the mean h-index. Detailed findings are presented and the rationale for using this approach for measuring and evaluating the research performance of HEIs is indicated*

Keywords: *quality of research, bibliometric indices, evaluation, Greek Higher Education Institutions (HEIs)*

1. INTRODUCTION

A core component of higher education reform in Europe is the systematic quality assurance and improvement of Higher Education Institutions (HEIs). Assuring quality in teaching, learning and research is no longer a matter only for Higher Education policy programs or broad international professional discussions. Quality development and assurance have long since come to play a central role in strategic Higher Education planning and in the everyday work of HEIs [1-3]. In Greece the evaluation (both internal and external) of HEIs is now obligatory in accordance with Law 3374/2005 [4] following also the European initiatives for a European Higher Education Area (Bologna process and Bergen report) [5].

For the assessment of the quality of research and the scientific contribution of HEIs and their research groups, a variety of approaches have been proposed, including expert-based qualitative approaches, such as evaluation by widely accepted researchers in specific disciplines with broad recognition in the scientific community (peer-review methodology). However, the rapid Internet proliferation and the easier access to scientific databases, offers an alternative approach to assessing the scientific outcome of a researcher or a Faculty. Nowadays, there seems to be a movement towards bibliometric measures and indices [6].

In this paper, the research output of all Academic Departments of the School of Pedagogical & Technological Education (ASPETE) is evaluated by using bibliometric indices such as the total and average publications and citations and the mean h-index. The data about each faculty member (surname, name and academic rank) were extracted from the website of each Department. The research outputs of faculty members were retrieved from Scopus® scientific database.

It is concluded that despite the inherent limitations of bibliometrics the viability of the adopted method for measuring and evaluating the scientific performance of higher education departments is effective in terms of Robustness, Validity, Functionality and Cost and Time Effectiveness. The useful results obtained suggest that such an approach could be used in a broader context.

2. QUALITY ASSURANCE AND EVALUATION IN GREEK HIGHER EDUCATION

Attempts made to introduce evaluation and/or quality assurance procedures at institutional and/or departmental level in Greek HEIs are reviewed in a number of recent publications; see [5, 7, 8]. The Law 3374/2005 [4] introduced a national quality assurance system in higher education according to the *European Standards and Guidelines (ESG)* and established the ECTS and the Diploma Supplement. It ensured the independent, objective and transparent function of the national system, which included the main elements of the four-stage model i.e., internal and external evaluation processes, publication of the report and international participation as well as peer review for the quality assurance agency). The

law clearly stated that the quality assurance system would be both an improvement and information tool and not a compliance one.

The European Credit Transfer System (ECTS), as it is referred above, was also established under Law 3374/2005, with the objective of evaluating the study programme undertaken by a student and recognizing the students' achievements during their period of study at a European university. The system of transfer and accumulation of units is already in use at universities in EU member countries at both the undergraduate and graduate levels. The system is based on the rule that 60 credit units represent one academic year's workload for a full-time student. That is, 30 credit units per semester or 20 units per trimester. In addition, the *Addendum of Degree* was established, which is an explanatory document that will be attached to the title of studies (degree). The document's purpose is to provide comprehensive information on the studies and the exact content of the studies undertaken by graduates [5].

The approval of the Law caused reactions to Universities by professors and by student unions, whilst on the other hand, was supported by all the TEIs which declared their willingness to be evaluated. They considered the evaluation as an opportunity to upgrade their status and to gain the competence to organize and operate postgraduate programs independently [7]. QA Law only became an active law (policy) in 2007.

According to the Law 3374/2005 the main goal of the Greek quality assurance (QA) system is to establish an integrated approach in order to record, comprehend, evaluate systematically and improve the activity and tasks of all higher education institutions regarding their mission and their profile. The quality of teaching and research, study programs and all other services provided by higher education institutions are assessed by internal and external procedures using objective indicators and standards in order to note their achievements and also to trace their weaknesses in such a way that they can be treated accordingly, with the state support. Evaluation may concern HEIs as a whole or particular Faculties or Departments or particular independent Units.

The law establishes an independent administrative authority called the Hellenic Quality Assurance Agency for higher education (HQAA or ADIP in Greek)) located in Athens, which coordinates the evaluation processes at a national level. HQAA consists of 15 members, including professors nominated by the rectors' and presidents' of technological education institutions conferences, student representatives, researchers and social partners. The HQAA is the body responsible for the smooth operation of the national quality assurance system. It supports the HEIs during their self-evaluation processes and keeps the competent bodies of the state and higher education institutions up-to-date concerning the international trends and developments in quality assurance. HQAA compiles keeps and revises a Register of Greek and foreign experts and specialists; it organizes the external evaluation process, keeps an archive containing all evaluation reports and annually submits a general report to the Parliament. In this report, it makes suggestions and recommendations regarding the improvement of the national higher education system. Last but not least, HQAA is also placed under a self-evaluation and peer-review process. Since September 2007, HQAA has been an associated member of the European Association for Quality Assurance in Higher Education (ENQA) [5, 7].

The "heart" of the Law 3374/2005 is article 3 entitled "*evaluation criteria and indices*". These criteria and indices refer to four axes:

(1) *Quality of tuition*: The efficiency of the teaching staff, the quality of the teaching process, the organization and implementation of the teaching tasks, teaching aids, media and infrastructures, the use of new technologies, the ratio of students to teachers and cooperation between teachers and students, the level and timeliness of the knowledge provided, the interrelation between research and teaching, the mobility of teaching staff and students.

(2) *Quality of the research work*: The fostering of research in the framework of the academic unit, the scientific publications, research infrastructures, research programs, the effectiveness of the research work, the originality of the research, the acknowledgment of the research by third parties, the research partnerships, research distinctions and awards as well as the participation of students in the research.

(3) *Quality of curricula*: The degree to which the curriculum meets the academic unit's objectives and the society's demands, the cohesion and applicability of the curriculum, the coordination of the syllabus, the rational organization of the educational institutions, the examination system, the support by available educational infrastructure.

(4) *Quality of the other services*: The effectiveness of the administrative services, student welfare services, all kinds of infrastructures, the use of new technologies, the transparency and efficiency in the management of the financial resources as well as in the use of infrastructure and equipment, cooperation with other educational or research institutions, whether Greek or foreign, as well as with the community.

Each HEI in Greece is required under the Law 3374/2005 to establish an Institutional Quality Assurance Unit (MODIP), to coordinate and support evaluation procedures. This unit is chaired by the HEI's vice-rector or vice president and includes representatives of the academic and administrative staff. Additionally, each academic Department appointed an Internal Evaluation Committee (OMEA), in order to collect data, documents and information so that to develop the Department's self-evaluation report. QA process at Greek HEIs works on a four-year cycle. The internal processes lead to the compilation of self-evaluation reports, while the HQAA controls the external review process (i.e. maintaining

registry of reviewers, setting up the review teams, compiling the external review reports). From the academic year 2009/2010, the Ministry of Education (MoE) requires all HEIs to submit a self-assessment report and to invite external evaluators for review. Without adoption of evaluation, Departments will face problems in relation to their operation (funding and human resources) [8].

3. EVALUATION OF ACADEMIC RESEARCH

3.1. Fundamentals

As it has been already mentioned in the previous section, one of the four axes of "*evaluation criteria and indices*" of the Law 3374/2005 is the "*quality of the research work*" performed in the HEI. In general, for the assessment of this aspect, a variety of approaches have been proposed, including expert based qualitative approaches, such as evaluation by widely accepted researchers in specific disciplines with broad recognition in the scientific community (peer-review methodology). However, the rapid Internet proliferation and the easier access to scientific databases, offers an alternative approach to assessing the scientific outcome of a researcher or a Faculty. Nowadays, there seems to be a movement towards bibliometric measures and indices [6].

In general a publication is considered as a 'building block' of science and as a source of data. Thus bibliometric assessment of research performance is based on one central assumption: scientists who have something important to say publish their findings vigorously in the open international journal (serial) literature. The common practice of scientific research shows that in most cases inspired scientists – particularly in the natural sciences and medical research fields – go for publication in the 'better' and, if possible, the 'best' journals. A similar situation is developing in the social and behavioural sciences, engineering and, to a lesser extent, the humanities [6, 9].

Besides bibliometric approach, for the assessment of the quality of research and the scientific contribution of HEIs and their research groups, a variety of approaches have been proposed. Typically expert-based qualitative approaches were applied, such as evaluation by widely accepted researchers in specific disciplines with broad recognition in the scientific community. This process, characterizes the model of faculty members' selection in most countries. However, it is not without drawbacks, since it requires significant resources and it is influenced by personal perceptions and the specific scientific profile of the evaluators [6]. More important it is very difficult to be applied to Departments or HEIs overalls due to very high expense of resources. As indicated in a recent publication; see [10], the superiority of bibliometrics over peer-review is evident for the natural and formal sciences, along the dimensions of:

- Robustness: bibliometrics allows evaluation of all, rather than a subset of overall output of a research group or a department.
- Validity: it avoids any distortions that could occur during internal selection of publications to be evaluated.
- Functionality: in providing evaluations for single scientists, then proceeding step by step to research groups, and ever larger aggregations, it permits each institution to allocate resources in an efficient manner.
- Cost and time effectiveness: it provides a dramatic saving on direct and indirect costs, and dramatically reduces time of execution.

Finally, bibliometrics is not limited to the evaluation of quality of research, but also permits the consideration of quantity. On the other hand, the authors are aware of the fact that the use of bibliometric techniques to assess the publication efforts of scholars is far from not being controversial. They know that there is a burgeoning debate about the convenience of the use of citation indicators; for the limitations and undesirable effects of the citation system, see [11]. However, they do believe that, in spite of the inherent limitations of bibliometrics, the viability of the adopted method for measuring and evaluating the scientific performance of HEIs is quite effective, especially when limited resources are available.

To the author knowledge there are only a few published studies concerning evaluation of HEIs or their Depts in Greek and in South-eastern Europe by bibliometric methods. A research in 2010 was focussed exclusively on Computer Science Greek Departments examining 552 faculty members using Google Scholar® and Publish or Perish® software [12]. In a similar previous publication, in 2008, an evaluation of Chemistry, Materials Science, Chemical Engineering and Physics Greek University Departments was presented. 601 faculty members were assessed by using h-index as calculated from the Web of Science® scientific database [13]. Recently 93 Greek University Departments from the fields of Social Sciences and Humanities, Sciences, Engineering, Pharmacy and Economics were evaluated according to their faculty members' h-index by using the Google Scholar® scientific database [6] whilst the evaluation of a number of Engineering Departments of TEIs in comparison to those in Universities, by a combination of a number of simple bibliometric indices and by using Scopus® was presented in [14]. Of major importance is also a recent publication comparing the research outcome of Economics Departments in Greece and Cyprus by using data from Scopus® database [15]. In this publication a ranking scheme for the corresponding Departments was also presented.

3.2. Bibliometric indices

For the effective and robust evaluation of research by bibliometrics of crucial importance is the selection of the appropriate bibliometric indices. It has been indicated; see [16] that "at all level of evaluation no indicator should be taken in isolation. A series of indicators representing the different facets of scientific activity should be employed".

In the present research indices selected corresponds to four axes of research output: productivity, impact, efficiency and hybrid (productivity + impact). The same scheme was used in a recent publication comparing the research of Economics Departments in Greece and Cyprus [15]. The indices used read as follows:

Productivity

- P: Total number of publications of academic staff in a Department.
- P_0: Total number of uncited publications of a faculty member (or on departmental level a "sum")
- P_f: Total number of publications of a faculty member
- P_{av}: Average number of publications per faculty member in a Dept. (P_{av}= P/N, N: number of faculty members in a Department)

Impact

- C: Total number of citations excluding self-citations (on a departmental level)
- C_s: Total number of citations with self-citations (on departmental level)
- C_f: Number of citations of a faculty member excluding self-citations
- C_{fs}: Number of citations of a faculty member including self-citations

Efficiency

- c_f: Average number of citations per publication of a faculty member, excluding self-citations (C_f / P_f)
- c: Average number of citations per publication on departmental level
- p: p-index (for a faculty member or on departmental level an "average")
- p_0: percentage of uncited publications (on departmental level)
- C_{av}: Average number of citations per paper (excluding self-citations) of departmental level

Note that the p-index corrects the C_f: index by giving emphasis on C_f rather than on P_f [17]. It is calculated by the form

$p= (C_f^2/P_f)^{1/3}$.

Hybrid (productivity + impact)

- h-index (for a faculty member or on departmental level as average)
- h_s-index (h-index taking into account self-citations - for a faculty member or on departmental level as average)

The h-index was introduced in 2005 by J. Hirsch [18], combining in a single indicator a measure of quantity and impact of the scientific output of a researcher. According to Hirsch, "a scientist has index h if h of his or her N_p papers have at least h citations each and the other (N_p-h) papers have ≤h citations each". The scientific community has shown a huge interest for this indicator, as shown by the high number of publications on the topic and its adoption by *Nature* and *Science* [19, 20]. In general, h-index results in the characterization of the scientific output of a researcher with objectivity, and therefore may play an important role when making decisions about promotions, fund allocation and awarding prizes. Moreover, it performs better than other single-number criteria commonly used to evaluate the scientific output of a researcher (impact factor, total number of articles, total number of citations, citation per paper rate and number of highly cited papers) [19]. Last but not least it has been found to correlate well with peer judgment [21].

However, several limitations of the h-index have also been remarked: Young researchers whose levels of publications are relatively low are handicapped since they are not involved many years in the research process. In addition, the publication policies across different scientific sectors vary. If a scholar has a low number of citations, this could be also attributed to a variety of reasons such as small impact in the field, due to work in field of a limited scope, publishing in a language other than English, or finally publishing mainly books. Also, the h-index may be increased not only by publishing new scientific papers, but also by increasing the number of citations on already published works. It is also non sensitive to the number of co-authors of a paper and thus their specific contribution to it [6, 14, 18].

4. EVALUATION OF RESEARCH IN ASPETE USING BIBLIOMETRIC INDICES

In an attempt to apply the evaluation of the quality of research in Greek HEIs by using bibliometric indices we select - on a pilot basis – all the Academic Departments of the School of Pedagogical & Technological Education (ASPETE). The Departments under consideration are:

- Department of Electrical Engineering Educators
- Department of Electronic Engineering Educators
- Department of Mechanical Engineering Educators
- Department of Civil & Structural Engineering Educators
- Department of Civil & Construction Engineering Educators
- General Department of Education
- General Department of Sciences

ASPETE provides concurrent technological and pedagogical education and training at tertiary level. Its mission includes the promotion of applied research in engineering disciplines, in educational technology and pedagogy, as well as the provision of training, further training or specialization for in-service or prospective secondary teachers. The degree issued by the five Technological Departments of ASPETE qualifies its holders to teaching the corresponding discipline in secondary education. It is awarded following the completion of a course of study of eight academic semesters including the submission of a graduation thesis and the practical work experience in the field. To obtain a degree equivalent to that of TEIs (Technological Education Institutions) in the same discipline, ASPETE's graduates may attend an additional fifth year of special studies at ASPETE. The General Departments of ASPETE support the School's Technological

Departments by providing the pedagogical and general courses that constitute an integral part of the curriculum [22]. Note that as of February 2012 all seven Departments of ASPETE have completed their Internal Evaluation (updated) Reports and submitted them to HQAA (ADIP). For two of the Departments, namely those of Mech. Eng. Educators and Civil & Structural Engineering Educators external evaluation were also realized, in January 2012 and June 2012, respectively. The corresponding reports can be found on ADIP's site; see [23] and [24], respectively.

The evaluation of academic research, for the case discussed here, was conducted at a faculty level (in total 58 faculty members were evaluated), as well at departmental level. The data about each faculty member (surname, name and academic rank) were extracted from the website of each Department. Only tenured academic staff was included. The research outputs of faculty members were retrieved from Scopus® scientific database. The data were collected during February 2013 and were last updated on 17/03/2013. There was no time period restriction; therefore, it should be obvious that the Departments under consideration were evaluated on the basis of the lifetime achievement of their faculty members.

Note that in Greece the Higher Education comprises of two "equivalent" sectors; one being the Universities (five years studies as far as engineering disciplines are concerned) and the other being the Technological one (TEIs) with four years studies. Nowadays, 18 Universities, two Technical Universities, the International Hellenic University, the Hellenic Open University and the School of Fine Arts compose the university sector whilst 15 Technological Education Institutions (TEIs) as well as the School of Pedagogical and Technological Education (ASPETE) compose the technological sector. Note, also, that until 2001, higher education included only the Universities and not the TEIs, which were considered as professional (vocational) Institutions (Polytechnics). HEIs consist of Schools or Faculties, Departments and Sections. The Department is the autonomous educational unit entitled to award degrees [5, 8].

Worth mentioning also that for faculty members in Universities there are four ranks, i.e. Professor, Associate Prof., Assistant Prof. and Lecturer); for all four degrees holding a Ph.D and having a number of publications is a prerequisite. On the contrary, in TEIs a lecturer/instructor is actually laboratory staff without obligation to perform research and to hold a Ph.D [14]. Note also that by the recent Law 4009/2011 which imposed the latest reform of Greek Higher Education the ranks of lecturer and the lecturer/instructor were abolished.

5. RESULTS AND DISCUSSION

Based on the procedure outlined in the previous section, the bibliometric indices presented in section 3.2 were calculated for each faculty member and the results for each Department were tabulated; see Tables 1-7. Then, the aggregate results were calculated for each Department; these results are summarized in Table 8. Values of c, p-index, p_0, h-index and h_s-index presented in the following Tables are the mean values of all faculty members holding a Ph.D in a given Department. Note also that data presented in Tables 1-7 were corrected for common issues (publications and citations).

Note, that traditionally, bibliometric studies were based on the number of publications and citations, using the well-known Web of Science® (WoS) distributed by Thomsom-ISI, which has dominated the world of multidisciplinary citation indexes. However, in 2004, two alternatives have become available. One of them is Scopus® (http://www.scopus.com/) developed by Elsevier and the other is the freely available Google Scholar® (http://scholar.google.com/). The comparison of these three databases is beyond the scope of the present study; see on this topic [15, 25, 26]. For the present case study Scopus® was selected since it offers the best coverage of scientific fields existed in ASPETE; see also [15].

Table 1. Bibliometric indices for the Department of Electrical Engineering Educators

	Bibliometric indices							
Academic Staff	P_f	P_0	C_{fs}	C_f	h_s	*h-index*	*p-index*	c_f
Prof. 1	49	19	138	106	5	5	6,01	2,16
Prof. 2	5	1	16	15	2	2	3,26	3,00
Assist. Prof 1	52	25	181	157	6	5	7,63	3,01
Assist. Prof 2	10	5	143	132	3	3	11,73	13,2
Lect. (Instruct.) 1	0	0	0	0	0	0	0	0
Lect. (Instruct.) 2	1	0	2	2	1	1	1,58	2
SUM	104	50	417	351				
AVERAGE (on staff holding PhD)	25,75	12,5	103,75	87,25	4,00	3,75	7,16	3,37

Table 2. Bibliometric indices for the Department of Electronic Engineering Educators

Academic Staff	Bibliometric indices							
	P_f	P_0	C_{fs}	C_f	h_s	*h-index*	*p-index*	c_f
Prof. 1	10	5	29	10	3	2	2,13	1,00
Associate Prof. 1	9	6	15	13	2	1	2,63	1,44
Associate Prof. 2	5	4	1	1	1	1	0,58	0,2
Assist. Prof 1	1	1	0	0	0	0	0	0
Assist. Prof 2	23	10	57	6	4	2	1,15	0,26
Assist. Prof 3	11	8	7	5	2	1	1,31	0,45
Assist. Prof 4	4	3	1	0	1	0	0	0,00
Lect. (Instruct.) 1	1	1	0	0	0	0	0	0,00
SUM	57	38	109	35		7		
AVERAGE (on staff holding PhD)	8,00	5,29	15,57	5,00	1,86	1,00	1,11	0,61

Table 3. Bibliometric indices for the Department of Mechanical Engineering Educators

Academic staff	Bibliometric indices							
	P_f	P_0	C_{fs}	C_f	h_s	h-index	p-index	c_f
Prof. 1	14	3	121	82	5	5	7.67	5.86
Associate Prof. 1	13	2	118	104	7	7	9.19	8
Associate Prof. 2	33	13	260	219	10	9	11.05	6.63
Assist. Prof 1	17	4	113	83	7	5	7.25	4.88
Assist. Prof 2	0	0	0	0	0	0	0	-
. Lect. (Instruct.) 1	0	0	0	0	0	0	0	-
Lect. (Instruct.) 2	0	0	0	0	0	0	0	-
Lect. (Instruct.) 3	0	0	0	0	0	0	0	-
SUM	77	22	612	488	-	-	-	-
AVERAGE (on staff holding PhD)	15,40	4.4	122.4	97.6	5.80	5.20	7.03	6.34

Table 4. Bibliometric indices for the Department of Civil & Structural Engineering Educators

Academic staff	Bibliometric indices							
	P_f	P_0	C_{fs}	C_f	h_s	*h-index*	*p-index*	c_f
Prof. 1	10	6	21	18	3	3	3,15	1,80
Associate Prof. 1	6	2	89	85	4	4	10,39	14,16
Assist. Prof. 1	0	0	0	0	0	0	0	0
Assist. Prof. 2	4	0	241	233	4	4	23,1	58,25
Lect. (Instruct.) 1	0	0	0	0	0	0	0	0
Lect. (Instruct.) 2	0	0	0	0	0	0	0	0,00
SUM	20	8	351	336	1,83	1,83		
AVERAGE (on staff holding PhD)	5	2	87,75	84	2,75	2,75	9,16	16,80

Table 5. Bibliometric indices for the Department of Civil & Construction Engineering Educators

	Bibliometric indices							
Academic staff	P_f	P_0	C_{fs}	C_f	h_s	*h-index*	*p-index*	c_f
Prof. 1	16	5	44	23	4	2	3,17	1,43
Associate Prof. 1	4	0	0	0	0	0	0	0
Assist. Prof. 1	21	6	148	107	6	6	7,99	5,09
Lect. (Instruct.) 1	0	0	0	0	0	0	0	0
Lect. (Instruct.) 2	0	0	0	0	0	0	0	0
SUM	41	11	192	130				
AVERAGE (on staff holding PhD)	13,67	3,67	64	43,33	3,33	2,67	3,72	3,17

Table 6. Bibliometric indices for the General Department of Education

	Bibliometric indices							
Academic Staff	P_f	P_0	C_{fs}	C_f	h_s	h-index	p-index	c_f
Prof. 1	2	2	0	0	0	0	0	0
Prof. 2	1	0	17	17	1	1	6,48	17,00
Prof. 3	0	0	0	0	0	0	0	0
Prof. 4	0	0	0	0	0	0	0	0
Prof. 5	0	0	0	0	0	0	0	0
Prof. 6	5	3	3	3	1	1	1,21	0,66
Prof. 7	5	1	64	64	2	2	9,14	1
Prof. 8	0	0	0	0	0	0	0	0
Prof. 9	0	0	0	0	0	0	0	0
Prof. 10	0	0	0	0	0	0	0	0
Associate Prof. 1	0	0	0	0	0	0	0	0
Associate Prof. 2	0	0	0	0	0	0	0	0
Associate Prof. 3	7	5	2	2	1	1	0,83	0,20
Assist. Prof. 1	1	0	3	3	1	1	2,06	0
Assist. Prof. 2	10	6	10	7	2	2	1,68	0,7
Assist. Prof. 3	7	4	74	63	3	3	8,1	10,57
Assist. Prof. 4	0	0	0	0	0	0	0	0,00
Assist. Prof. 5	16	4	244	217	7	6	13,95	13,5
Assist. Prof. 6	0	0	0	0	0	0	0	0
Assist. Prof. 7	8	7	2	2	1	1	0,79	0,25
Lect. (Instruct.) 1	0	0	0	0	0	0	0	0
SUM	56	32	417	376				
AVERAGE (on staff holding PhD)	2,8	1,6	20,85	18,80	0,95	0,90	2,21	6,71

Table 7. Bibliometric indices for the General Department of Sciences

Bibliometric indices								
Academic Staff	P_f	P_0	C_{fs}	C_f	h_s	*h-index*	*p-index*	c_f
Prof. 1	1	0	6	4	1	1	2,49	4,00
Assist. Prof. 1	34	2	622	513	11	10	19,19	15,08
Assist. Prof. 2	5	1	34	24	2	2	4,78	4,8
Lect. (Instruct.) 1	22	1	347	310	9	9	15,89	14,09
SUM	62	4	1009	851				
AVERAGE (on staff holding PhD)	15,50	1	252,25	212,75	5,75	5,50	10,59	13,72

Table 8. Cumulative bibliometric indices for all Departments

DEPARTMENT	Dept of Mechanical Engineering Educators	Dept of Electrical Engineering Educators	Dept of Electronic Engineering Educators	Dept of Civil & Construction	Dept of Civil & Structural Engineering Educators	General Dept of Education	General Dept of Sciences
Academic Staff	8 (5)	6(4)	8(7)	5(3)	6(4)	21(20)	4(3)
P:	77	104	57	41	20	56	62
P_0	22	50	38	11	8	32	4
C	488	351	35	130	336	376	851
C_s:	612	417	109	192	351	417	1009
P_{av}	15,4	25,75	8	13,67	5	2,8	15,5
C_{av}	97,6	87,25	5	43,33	84	18,8	212,75
c	6,34	3,37	0,61	3,17	16,8	6,71	13,72
p-index	7,03	7,16	1,11	3,72	9,16	2,21	10,59
p_0	0,28	0,48	0,66	0,26	0,4	0,57	1
h-index	5,2	3,75	1	2,67	2,75	0,9	5,5
h_s-index	5,8	4	1,86	3,33	2,75	0,95	5,75

All data were retrieved from Scopus®; last accessed 17/03/2013
For all Departments numbers in ( ) indicate the faculty members holding a Ph.D.

The first indices examined comprise; see Table 1-8, citations per faculty member, papers per faculty member and citations per paper. The first of those, namely citations per faculty member is the product of the other two. The importance, of the impact of the research of a department's faculty members consists of the following two components: the average productivity of its members (papers per faculty member) and the average impact of these articles according to the citations they receive (citations per paper). High productivity and high impact result to a high reputation of the Department in the research community. Variations in the productivity and the impact of publications have a combined effect to its research reputation.

To start with, from the data presented in Tables 1-7 it is evident that there is a large variance between the

performances of the faculty members of the various Departments of ASPETE. This observation support the opinion that the majority of HEIs is quite heterogeneous, containing both excellent and "average" Departments. The aggregation (averaging) can influence the overall picture (reputation) of an Institution; see [12, 27]. Moreover, from the data reported in [14], it is evident that all indices are quite higher for a same-field University Department in comparison with TEIs. The inherent differences in the nature and the historic evolution of these two types of HEIs are the main reasons for such deviations [14].

A direct comparison can be made, only, among the four engineering Departments of ASPETE. In general, Department of Mechanical Engineering Educators gets the highest indices as far as C_{av} and C are concerned and also the second highest P_{av}. On the contrary, mean indices for the Department of Electronic Engineering Educators and the Department of Civil & Structural Engineering Educators are, in general, the lowest ones. Worth mentioning that in Department of Civil & Construction Engineering Educators the 50% of P and the 82 % of C belongs to just one faculty member; see Table 5.

The indices for the General Department of Education are considerably lower than expected; the practice of publishing in Greek edited volumes and books may explain, partially, this observation. For both the General Departments of Education and of Science the average indices presented in Table 8 should, actually, be credited to a very small portion of their faculty member; i.e., a type of Pareto distribution is evident, see Tables 6 and 7.

The previous analysis highlights the research potential of each department, based on the research publications that have been made throughout the research life of a faculty member. The presentation, however, of data for a more recent period; for example the last 3 or 5 years, would be also enlightening.

In general, results in Table 8 should be read and analyzed in conjunction with the detailed data presented in Tables 1-7 and having always into mind the need of using multiple indicators for the assessment of HEIs' research [16, 28] as well as the fact that publication-related activities is only one output in the knowledge transfer process of HEIs [29].

The compatibility of the proposed methodology with the requirements of HQAA (ADIP) for the internal self-evaluation and the external evaluation of academic Departments should be also addressed. For the 2nd axis of evaluation, i.e., "*Quality of the research work'* ADIP suggests the following criteria:

- Promotion of research from the Academic Unit
- Originality of the research
- Research programs
- Effectiveness of the research
- Recognition of research by third parties
- Research partnerships & co-operations
- Research infrastructures
- Scientific publications
- Honors and awards
- Participation of students to research activities.

Moreover, ADIP suggests the use of a standardized e-file ("overview of information of Unit under evaluation"). From the Tables included in this file, Table 15 refers to the number of scientific publications; Table 16 refers to scientific recognition whilst Table 17 refers to research projects and participation to scientific societies and committees.

By comparing the columns of Tables 1-7 with the columns of the above mentioned Tables it is concluded that bibliometric indices oversubscribe data required in Tables 15 & 16 but offer no information for Table 17. A previous research revealed, that in general, indices and metrics of ADIP are, more generalized, but they are lacking of "objective evidence" when compared with the bibliometric indices proposed herewith; see also [28].

Worth mentioning, also, that typically, internal evaluation reports contains a section of the research outcome of the faculty staff, which, in most cases, at least in TEIs, is a list of publications submitted by the members themselves. The external evaluation reports, judging from the reports available on ADIP's site, usually, comments in general on the topic or discussed it only marginal, with no standard procedure or benchmarking-type approach.

Due to restrictions of space the findings of the external evaluation reports can not be analyzed further. However, it should be noted that despite the claimed "concurrent technological and pedagogical education" [22], low levels of synergy between the pedagogical and technological sectors were identified, both according to External Evaluation reports [23, 24] and to detailed results summarized in Tables 1-7.

6. CONCLUSIONS

The research output of all seven Departments of the School of Pedagogical & Technological Education (ASPETE) was evaluated by using bibliometric indices such as the total and average publications and citations and the mean h-index. Bibliometric evaluation on departmental level is fast and effective, especially when one uses simple measures like the h index and average values. With relatively little effort this activity can be extended to all Greek HEIs.

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