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Evaluation of the Importance Given to the Various Teaching Subjects Within Study Programmes, of the Same or Different Scientific Discipline Departments in Higher Education Institutions: a Criteria-based Approach

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Abstract The purpose of this article is to describe an updated version of a previous specific study, as well as the creation and implementation of a criteria-based approach that was applied to it. Above all, the goal of this paper is to give necessary additional information and instructions, so that the same criteria-based process, as well as the accompanying methodology, can be easily used by researchers for other related aims regarding Higher Education Institutions (HEIs), after applying appropriate amendments or adjustments.

Keywords: *evaluation, higher education, study programmes, scientific discipline, digital transformation*

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1. Introduction

This study constitutes an updated version of the overall research conducted during development of the Ph.D. thesis by Chris P. Lamprou entitled "Physical Education Analytical Programs in Primary and Middle school curriculum, and undergraduate programs in the Departments of Physical Education and Sport Sciences in Greece: a critical and comparative study of the period 1983-2008" for the Pedagogical Department of Secondary Education, in the National and Kapodistrian University of Athens [1,2,3,4].

The purpose of this article is to describe the previous specific study [1] as well as to look at the creation and implementation of a criteria-based approach that was applied to it. Above all, the aim of this article is to give necessary additional information and instructions, so that the same criteria-based process, as well as the accompanying methology can be easily applied to Higher Education Institutions (HEIs) by researchers, in the future. It should be underlined that "Higher Education Institutions (HEIs)" is the term used in Europe when referring to Institutions/Organizations providing Higher/Tertiary University Education, by undergraduate programmes (Educational Attainment Level ISCED 6: 'first cycle' or Bachelor's Degree), graduate/postgraduate programmes (Educational Attainment Level ISCED 7: 'second cycle' or Master's Degree) (Educational Attainment Level ISCED 8: 'third cycle' or Doctoral Degree or Ph.D. level) [5,6].

The previous specific research aimed to evaluate the correlation between the undergraduate programmes (Higher Education/H.E.) offered by Departments of Physical Education and Sports Sciences (DPESS) and the Physical Education (P.E.) curriculum followed in Greek Primary school (: years 6-12, Primary Education) and Middle school (: years 13-15, Secondary Education). Basically, we investigated whether the perspective P.E. teachers were adequately prepared (after their graduation) to teach the thirteen (13) main athletic subjects of the P.E. school curriculum [1,2,3,4].

After extensive literature research, mainly related to the discipline or field of H.E. [7], no recorded relevant study, or process, applied and/or adapted to Higher/Tertiary/University Education was found that could be useful for our study to use. So, it was decided that a process should be created from square one. Based on this, the related theoretical framework, as well as the limitations of the previous research, we proceeded to create a criteria-based process/approach, in order to evaluate the importance given to these thirteen (13) main teachings subjects, within the Study Programmes of each Department of PESS (same scientific discipline Departments).

What should be pointed out is that academic Departments are specialized units within a University that focus on specific Disciplines or Fields of study [8]. We also decided to use the term teaching "subjects" in Study Programmes/Undergraduate Programmes within HEIs. Teaching "subjects" are also described internationally as "courses", "degree courses", "semester modules", "modules", "units" etc. We decided to use the term "subjects", because we judged it to be the best choice both for our research and in the international bibliography. Teaching "subjects" constitute the structural units of the HEIs Study Programmes about the "Subjects" or the "Field" ("Field of Education and Training", "Field of Study"), or the "Discipline" or the "Branche" or the "Area", of "Education and Training" in Higher Education, internationally.

2. Research methodology - Limitations

Regarding the specific research carried out during the previous study [1], it was decided to focus on the undergraduate Study Programmes which covered the period from the academic year 1983-4 to the academic year 2007-8, i.e. a total of 25 academic years. So, the related material in the previous research covered the period from 1983 to 2008 and included the undergraduate catalogs of the five Greek D.P.E.S.S. [9,10,11,12,13].

The following should be noted:

1. The previous study focused only on undergraduate programs ('first cycle' or Bachelor's Degree) and not on graduate/postgraduate programmes ('second cycle' or Master's Degree) ('third cycle' or Doctoral Degree or Ph.D. level) [1,2,3,4]. For the relevant theoretical framework, it is recommended for readers and/or researchers to collect useful information about the European Credit Transfer and Accumulation System (ECTS) [14] and ECTS-Users' Guide 2015 [15]. However, researchers in the future could use the process described in this study, both in the 'first', and/or 'second', and/or 'third cycle' [1,2,3,4].

2. Regarding the five DPESS, we attempted to locate undergraduate catalogs and information about the content of all undergraduate programs for every academic year of the set research question. After submitting applications to each department's secretariat and Student Administration Office, we received a total of fifty-three (53) detailed undergraduate catalogs. In addition, six (6) were available online, in digital format. Eventually, we managed to amass a total of fifty-nine (59) undergraduate catalogs, covering the vast majority of the undergraduate programs over the total academic operational years, without risking the validity of our findings [1]. Nevertheless, it is necessary we be aware of the limitations imposed by the sample of the obtained undergraduate catalogs; a greater sample would allow any prospective researcher(s) to get more accurate estimations [1,2,3,4]. Without doubt, the research would have benefitted from a larger selection of undergraduate study programmes and/or undergraduate catalogs [1].

3. In our previous research we decided to study the period 1983-2008, although the criteria-based tool which was used and which is discussed in this article can be applied for the period from one semester up to as many academic years as we decide for similar researches in HEIs.

The characteristics of the undergraduate study programmes, the existing Greek institutional and legal framework and the nature of the data available accounted for some limitations in the previous study [1], since:

1. As we mentioned before, we were not able to analyze some undergraduate catalogs for certain academic years due to the fact that it had not been possible to retrieve them from the department's secretariat, the Student Administration Office, or the University Libraries, because they had not been kept as records. However, all undergraduate catalogs that were made available to us, along with Proceedings of the Departments' General Meetings, were considered for our research. The latter provided complementary information about the undergraduate programmes, especially in those cases where undergraduate catalogs do not exist [1,2,3,4]. It was therefore recommended that future researchers consult such departmental records in order to collect useful information [1].

2. Regarding the five Departments' detailed undergraduate study programmes, in some cases we were able to process only indicative data and approximations - rather than factual data, as there were no single catalogs per academic year. This lack of clarity is also documented in many undergraduate catalogs, for instance regarding the allocated hours per week for each subject, and other details [1,2,3,4]. However, even these approximations were deemed valuable to our research, as they constituted the main elements of PE teacher education in the University Departments in question [1].

It should be pointed out that this data should come from the Secretariat of each University Department (as long as the Secretariat has an institutionalized function and procedure for the relevant digital archives) and should concern recorded and real data. This process should be under the responsibility of the Secretariat of each University Department. Then, in correlation with the data of the Study Guides, this basic limitation of the specific research, as well as any related/similar research and process in the future, is very easily overcome.

The Digital Transformation of all processes related to the Secretariats of University Departments is a decisive issue in line with the reality of Greek Higher Education. It is characteristic that, according to the goals and the statutory framework [16] of the Greek State, in the Bible of Digital Transformation, with regard to the projects that are in progress, it is considered necessary there be an upgrade to the information systems of the HEIs for the

digital storage and processing of all the activities of the Universities (Financial Services / Administrative Services / Protocol / Asset Management) [17]. The Digital Transformation of Higher Education started at the end of the 20th century [18]. The COVID19 pandemic has highlighted new trends and challenges for Digital Higher Education on an international/global level [19] while Artificial Intelligence is already present in Higher Education (as the most modern phase in its digitalization process), while the framework for its use within Universities has been formed (not in all countries and to the same extent between HEIs) [20,21,22,23,24,25]. Researchers on related issues conclude that Digital Transformation represents a process of change within educational institutions, necessitating a holistic analysis [26].

3. In the field of undergraduate study programmes there are theories that express scholars' concerns regarding their intention, implementation and effectiveness, which complicate evaluation efforts/assessment attempts, upon which our research draws [1,2,3,4]. In fact, undergraduate programmes, as a rule, can be described either by what is originally determined for and offered to students, or by what knowledge learners gain through their academic experience [27]. This distinction is represented in the difference between the questions: "What must students learn in an undergraduate program?" and "Which elements of an undergraduate program affect students' learning?". It is more appropriate to evaluate undergraduate programs based on their objectives (learning objectives) rather than on their outcomes, as determining the actual learning achieved by the end of these programs can be troublesome [28]. Most research on the evaluation of undergraduate programmes and their effectiveness is mainly hypothetical, rather than factual. Therefore, it is important we make a distinction here between programmes that follow a rigid structure towards what a degree requires, and programmes of stydy in which students really choose for themselves [1,2,3,4].

The main technique chosen for studying the archives was the analysis and processing of the material [29,30]. The resulting data from this process was collected, codified, quantified, and processed with the use of statistical charts and tables, as well as with the Statistical Package for the Social Sciences software (SPSS). In any case, previous research [1] utilized the following methods [29]: a) the study of sources, archives and statistical data, b) content analysis, and c) Multidimensional Scaling solutions in Trigonometric transformations (MDS-T) [1,2,3,4,31].

3. Previous Research' Design

The previous specific research compared the PE curriculum of Primary school and Middle school, with the content (learning objectives) of the undergraduate programmes of the five DPESS in Greece (in Athens, Thessaloniki, Komotini, Serres and Trikala) [1,2,3,4].

Henceforth, the terms 'Analytical Program' (AP) and 'PE (school) curriculum' refer to both Primary school (Primary Education) and Middle school (Secondary Education), while 'undergraduate programme(s)', 'undergraduate catalog(s)', 'first-cycle degree programme(s)', 'general catalog(s)', 'course catalog(s)' refer to DPESS (Higher Education) [1,2,3,4]. The term 'undergraduate catalog(s)', refers to the department's undergraduate catalog/general catalog/course catalog, i.e. the information package that includes all the necessary information regarding the Institution, the Department, the Department's undergraduate programme / first cycle degree programme (e.g. the Department's function, the programme structure, etc.) and other broad but useful information for students (e.g. student affairs office, study facilities, financial support for students, insurance, extra-mural and leisure activities, student associations etc.) [1,2,3,4]. It should be mentioned that the term 'curriculum' is used in our study referring only to Primary and Secondary Education and not to Higher Education [1,2,3,4].

We chose to limit the previous study [1] to the PE curriculum of Primary school ('Dimotiko' – years 6-12) and Middle school ('Gymnasio' – years 13-15), excluding High school ('Likeio' – years 16-18), for the following reasons: a) Primary school and Middle school constitute the 9-year compulsory education in Greece, b) the age from 6 to 15 years old is considered particularly important for shaping what role PE will play in a child's life and c) the then underlying philosophy of Primary and Middle school PE curriculum in Greece [1].

The time period (1983-2008) was selected because: a) the academic year 1983-4 saw the launching of the DPESS in Athens and Thessaloniki (former National PE Academies); b) 2008 was the final year before the reform plan for compulsory education (Cross Thematic Curriculum Framework - CTCF), which was introduced by the Greek Pedagogical Institute [32] and included the development of PE teaching material for teachers and pupils; c) the academic year 2007-8 marked the 25th anniversary since the establishment of the first two PESS departments in Athens and Thessaloniki (the 24th for Komotini, the 23rd for the one in Serres, and the 14th for Trikala), which was also the first year these departments, among all other HEIs, were called by the Greek Ministry of Education to undergo internal and external evaluation procedures [1,33,34,35].

From the foundation laid by the related curriculum in Primary school and Middle school, and from the analysis of the five departments' undergraduate catalogs, emerged the need to group and investigate the following thirteen (13) taught athletic subjects: 1) Gymnastics (Basic – Pedagogical), 2) Gymnastics with the use of Equipment, 3) Rhythmic Gymnastics, 4) Classical Athletics, 5) Basketball, 6) Volleyball, 7) Handball, 8) Football, 9) Traditional Greek Dance, 10) Psychomotor Education, 11) Music and Movement Education, 12) Games, and 13) Swimming [1,2,3,4].

These distinct educational subjects established the required point of reference, based on which our research attempted to evaluate the correlation of PE curriculum in Primary school and Middle school and undergraduate programmes in the five DPESS [1,2,3,4]. This study aimed to define, through a set of criteria, the value or the importance placed upon each of the aforementioned educational subjects in the design of each undergraduate programmes [1,2,3,4].

We argue that this was a valid method in order to reach important conclusions about these educational subjects, measuring whether each undergraduate program placed greater or lesser importance upon them, in the PE teacher education. At the same time, statistical analysis of the results could showcase whether there was a shift in the philosophy of the undergraduate programs for each department over the period 1983-2008 [1,2,3,4].

A few points need to be stressed here [1,2,3,4]:

a) It was possible for a DPESS to include two or more Paths (including PE teacher education or not). Therefore, students were required to select some Path sub-subjects, offered in certain academic years and semesters. These Paths were not limited to PE teacher education but can also be extended to: 1) Health and Fitness, 2) Sport Coaching, 3) Sport Management [1,2,3,4].

b) All undergraduate catalogs of the five departments contained the common element of Specialization. In other words, in the last one or two years of each undergraduate program, students could select at least one Sport Specialization, in order to obtain specialized Sports' Coaching qualifications. Therefore, students were also required to choose some Specialization sub-subjects, offered in certain academic years and semesters. In some departments, this Specialization was not limited to Olympic or non-Olympic Sports, but could also extend to (more) theoretical Specializations - for instance, Athletic Journalism, Sports for All, Adapted Physical Education and Olympic Studies [1,2,3,4].

c) In any case, the DPESS Diploma encompassed many different fields, and graduates of any one of the five DPESS were entitled to work in the corresponding professional field of PE in Primary, Secondary or Higher Education [1,2,3,4].

d) Every DPESS made efforts to describe and distinguish each teaching subject according to the relevant instructions given by the Hellenic Quality Assurance and Accreditation Agency [1,34,35,36]. For this reason, all undergraduate catalogs divide the offered subjects into Compulsory (C.), Compulsory Elective (C.E.), and Optional (O.). Subjects are also categorized as Main Core (M.C.), Path (P.) or Specialization (SP.). Compulsory subjects are Core subjects. Compulsory Elective subjects can be of all three types (Core, Path, or Specialization). Optional subjects are Core subjects which can also function as Path or Specialization subjects, according to undergraduate program requirements. For example, when a Specialization in a particular sport is offered, without being included in the department's Compulsory subjects, the equivalent Optional subjects become prerequisites for students who want to follow this Specialization [1,2,3,4].

4. Formulation of Evaluation Criteria-based Tool

The fifteen (15) criteria employed for the previous research [1,2,3,4] emerged from the analysis of the five departments' undergraduate catalogs. The use of just a single criterion, or rather a smaller number of criteria, would not lead to satisfactory findings about the value placed in each taught athletic subject. This is also addressed within some catalogs, in an attempt to provide correct information to prospective students and lecturers of the five same discipline's departments in question. For instance, when referring to the European Credit Transfer and Accumulation System (ECTS), one catalog for the undergraduate program in Serres (AUTH) states that "it would be inaccurate to weigh the importance of each athletic subject with its associated ECTS credits" and that "each subject's importance must be described within the department's undergraduate catalog." (AUTH-DPESS-Serres catalog, 2007-8, p. 20) [1]. Although the undergraduate catalogs offer no further clarifications, the use of the verb "describe" implies that any research that aims to draw conclusions about the importance given to an athletic subject to the overall program, needs to originate from and rely on criteria emerging from the descriptions found in the departments' undergraduate catalogs. This view was adopted and employed in our study for each of the thirteen (13) athletic subjects, resulting in a total of fifteen (15) characteristics/criteria [1,2,3,4].

The criteria formulated for the evaluation of the thirteen (13) main athletic subjects of the five university departments' undergraduate catalogs were the following [1,2,3,4]:

1. The Number of Sub-Subjects (N.S.S.) relevant to a main athletic subject [1]. We provide the mean value(s) of athletic sub-subjects offered per department, according to the undergraduate catalogs, which are relevant to the main athletic subject for every academic year each department was fully operational (i.e. it offered all four years required for the completion of the undergraduate program) [1,2,3,4].

2. The Number of different Semesters (N.S.) in which sub-subjects, relevant to a main athletic subject, are offered [1]. The mean value of semesters will be used here [1,2,3,4].

3. The Number of Compulsory Sub–Subjects (N.C.S.S.) relevant to a main athletic subject [1]. The mean value for each department was recorded [1,2,3,4].

4. The Number of Compulsory Elective Sub-Subjects (N.C.E.S.S.) relevant to a main athletic subject [1]. The mean value for each department was recorded [1,2,3,4].

5. The Number of Optional Sub-Subjects (N.O.S.S.) relevant to a main athletic subject [1]. The mean value for each department was recorded [1,2,3,4].

6. The Percentage of Compulsory Sub-Subjects (P.C.S.S.) relevant to a main athletic subject of the total number of compulsory subjects required for the completion of the undergraduate program [1,2,3,4].

7. The Number of Main Core Sub-Subjects (N.M.C.S.S.) relevant to an athletic subject [1]. The mean value for each department was recorded. The word 'Main' is used in order to make a clear distinction between the abbreviation for criterion no.3 (N.C.S.S) and the abbreviation for criterion no.7 (N.M.C.S.S.) [1,2,3,4].

8. The Number of Path Sub-Subjects (N.P.S.S.) relevant to a main athletic subject [1]. The mean value for each department was recorded [1,2,3,4].

9. The Number of Specialization Sub-Subjects (N.SP.S.S.) relevant to a main athletic subject [1]. The mean value for each department was recorded [1,2,3,4].

10. Subject Hours Per Week (S.H.P.W.) [1]. There is no distinction among theory, practice, laboratory work, and seminar hours for each subject. For this study, we only recorded what was written in each undergraduate catalog.

It is the mean value of hours that sub-subjects relevant to a main (athletic) subject were taught in each department [1,2,3,4].

11. Teaching Credits (according to the European Credit Transfer System-ECTS or not) [14,15,37,38] (T.C./ECTS) associated with the main (athletic) subject. It is the mean value of teaching credits of all sub-subjects relevant to the main (athletic) subject per department [1,2,3,4]. ECTS is a learner-centered system for credit accumulation and transfer, based on the principle of transparency of learning, teaching and assessment processes. Its objective is to facilitate planning, delivery and evaluation of study programs and student mobility by recognizing learning achievements and qualifications and periods of learning. For issues of "ECTS equivalence" between universities in many countries around the world (within and outside Europe), researchers can consult the relevant comparative "ECTS equivalence table" of the Hellenic National Academic Recognition and Information Center [39].

12. Percentage of the Number of total Teaching Credits originating from Compulsory Sub-Subjects (P.N.T.C.C.S.S.) relevant to a main (athletic) subject, from the total number of minimum teaching credits required for graduation [1]. The mean value for each department was recorded [1,2,3,4].

13. The Order (ORDER) in which every sub-subject's 'syllabus' is presented among others within each undergraduate catalog department [1]. The term "syllabus" is officially used to describe the content of every teaching sub-subject, in Ministerial Decisions, No. F5/89565/B3/2007 [37]. The order in these descriptions is related to: a) whether the sub-subject is Compulsory (a Core subject) or Compulsory Elective (Core, Path, or Specialization) or Optional (Core, Path, or Specialization), b) whether the sub-subject is delivered from the first to the eighth semester and c) whether the sub-subject is considered – always according to the undergraduate catalog, and therefore, the department – a fundamental study department [1,2,3,4].

14. The Preparatory (PREPARATORY): (YES)-(Not Registered)-(NO): (1)-(0)-(-1) pertains to whether the sub-subject prepares students to become PE teachers department [1]. This attribute is present when particular words and phrases referring to PE teaching in Primary and Secondary Education are identified within each undergraduate catalog, or when words and phrases appear that refer to the sciences of Educational Psychology, Developmental Psychology, Pedagogy, Teaching Methods of Physical Education generally or the Teaching Methods of main athletic subjects (thirteen/13 main athletic subjects of Primary and Middle school's curriculum) [1,2,3,4]. The positive identification of these characteristics shows in part that the teaching of this subject has been harmonized with the sciences referred to [1,2,3,4].

15. SPECIALIZATION: (YES)-(NO): (1)-(0): Specialization has been offered in all DPESS since their first academic year [1]. This attribute refers to whether Specialization in the main athletic subject in question was offered by each of the five DPESS [1,2,3,4].

5. Results – Discussion

After recording all the resulting data, the next decision we had to make was how we would perform the statistical processing.

1. The first decision was that obviously -after recording them- the mean values of the criteria should be studied.

2. Regarding the set of recorded data, we should use a Multivariate Analysis. The known possibilities of the statistical processing of data with the use of the Trigonometrically transformed Multidimensional Scaling solutions on the circle (MDS-T) [31] guided us to this choice [1]. Our statistical analysis followed a two-stage process. First, the formulation of our fifteen (15) criteria was explored by computing trigonometrically transformed Multidimensional Scaling solutions (MDS-T) [31]. MDS-T involved first analyzing the data through standard unconstrained Multidimensional Scaling analysis (MDS) followed by trigonometric transformations of the coordinates on the circumference of a circle [1,2,3,4,31].

A software application for computing two -and three-dimensional MDS-T solutions and graphically displaying them, programming by G. Santipantakis [40], can be freely downloaded. This application was developed as part of the Papazoglou & Mylonas publication [41]. Based on MDS-T, conclusions were drawn not only from measurements based on the criteria, but also in terms of the criteria themselves which were formulated, selected and used for this specific research [1].

However, this thesis does not preclude the fact that other researchers of similar issues about Higher Education could choose and use some other Multivariate Analysis.

3. Based on the results and capabilities of the Trigonometrically transformed Multidimensional Scaling solutions on the circle (MDS-T) [1,2,3,4] we were led to choose and study a set of criteria from those we used and/or groups of selected criteria. In the following sections we present observations from the analysis of undergraduate catalogs and their corresponding undergraduate programs [1,2,3,4].

5.1. Mean Values of the Criteria

(The relevant Mean Value Tables, MDS-T Figures, Tables of Cluster Analysis and Figures/Mean Value Diagrams referred to in the following sections are available upon request by the corresponding author.) The tables of mean values, resulting from the processing of the five departments' undergraduate catalogs, lead us to certain overall observations about the teaching of the thirteen (13) main athletic subjects (for each academic year they were offered) in the undergraduate programs of these departments (/DPESS) [1,2,3,4,31].

For all five DPESS: By studying the final mean values of the main athletic subjects' criteria ranking in all departments, we observe a general emphasis on 4, 5, 6, 1, 8, 7, and 13 (Classical Athletics, Basketball, Volleyball, Gymnastics, Football, Handball, and Swimming, which rank the highest), rather than on 12, 10, and 11 (Games, Psychomotor Education, Music and Movement Education, which rank the lowest) [1,2,3,4].

As an indication, we present: 1) Table 1: The mean values of the fifteen criteria about the athletic subject 11 (Music and Movement Education) at the five DPESS [1]. 2) Table 2: The mean values of the fifteen criteria about

the athletic subject 4 (Classical Athletics) at the five DPESS [1].

Table 1. The mean values of the fifteen criteria about the athletic subject of 11 (Music and Movement Education) at the five DPESS [1]

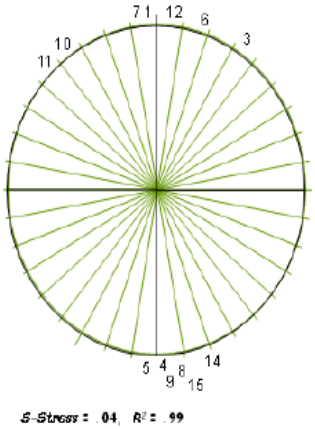
Criteria - DPESS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Athens (NKUA)	2,25	3,417	0	0,583	1,667	0	1,667	0,333	0,25	2,013	2,146	0	73,653	1	0,125
Thessaloniki (AUTH)	1,708	5,396	0,833	0,479	0,5	1,391	1,375	0	0,479	1,729	1,665	0,731	72,478	0,417	0
Komotini DUTH)	3,381	4,095	0,905	1	2,286	1,489	3,190	0,857	1	2	2	0,866	114,25	0,429	0
Serres (AUTH)	1,95	3,2	1	0	0,95	1,665	1,95	0	0	1,5	1,5	0,445	96,885	0,4	0
Trikala (UTH)	3,364	4,091	0,364	2,182	1	0,758	1,364	2	0,182	1,301	1,875	0,274	13,5	0,182	0

Table 2. The mean values of the fifteen criteria about the athletic subject 4 (Classical Athletics) at the five DPESS [1]

Criteria - DPESS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Athens (NKUA)	3	3	3	0	0	7,505	3	0	0	1,958	2,042	4,424	59,573	1	1
Thessaloniki (AUTH)	2	2	2	0	0	4,273	2	0	0	4,792	3,938	4,307	12,076	0,917	1
Komotini DUTH)	3,048	3,048	1,714	1,333	0,762	2,797	3,048	0,762	1,333	1,905	2,190	1,709	20,063	-0,214	1
Serres (AUTH)	2,65	2,65	2,65	0	0	2,906	2,65	0	0	4,625	4,625	4,641	3,667	0,4	1
Trikala (UTH)	2	2	2	0	0	4,391	2	0	0	4,182	3,091	2,985	5,5	0,182	1

5.2. Multivariate Analysis (MDS-T)

The MDS-T solutions lead us to a number of interesting observations, not only about the thirteen (13) main athletic subjects, but also about the fifteen (15) criteria used during the analysis of the undergraduate programs and their undergraduate catalogs for each academic year [1].



Criterion	Place
14: PREPARATORY	163°
15: SPECIALIZATION	169°
8: N.P.S.S.	174°
9: N.SP.S.S.	178°
4: N.C.E.S.S.	179°
5: N.O.S.S.	-177°
11: T.C./ECTS	-42°
10: S.H.P.W.	-36°
7: N.M.C.S.S.	-6°
1: N.S.S.	-3°
12: P.N.T.C.C.S.S.	6°
6: P.C.S.S.	19°
3: N.C.S.S.	31°

Figure 1. MDS-T configuration for the (13) criteria (and their Place) in all five (5) departments. (The column named 'Place' corresponds to each criterion position on the circumference of the circle, as displayed in the respective Figure, expressed in degrees, according to the angle it forms with the vertical Y axis.) [1]

Based on the solution for the collective findings from all departments/DPESS (Figure 1) [1,2,3,4], thirteen (13) criteria (out of the fifteen originally selected) form two groups: the first one includes criteria 1 (N.S.S.), 3 (N.C.S.S.), 6 (P.C.S.S.), 7 (N.M.C.S.S.), 10 (S.H.P.W.), 11 (T.C./ECTS), and 12 (P.N.T.C.C.S.S.); the second contains criteria 4 (N.C.E.S.S.), 5 (N.O.S.S.), 8 (N.P.S.S.), 9 (N.SP.S.S.), 14 (PREPARATORY), 15 (SPECIALIZATION). In relation to our research problem, we believe that the first criteria group has an increased importance value in comparison to the second; in other words, we can refer to them as primary and secondary criteria groups. The solutions for each DPESS (Tables of Cluster Analysis) confirmed these criteria grouping but also showed a few subsets. However, in order to compensate for the limitations pertaining to data collection, as explained in part 2, 3 "Research methodology – Limitations", "Previous research design", we opted to select the general grouping explained above as primary and secondary criteria groups, which is also recommended for future studies [1,2,3,4].

For instance, when we attempt to evaluate the presence of each of the thirteen (13) main athletic subjects for any DPESS over the undergraduate program of its operation years, we may select the three criteria that pertain to Compulsory subjects: 3 (N.C.S.S.), 6 (P.C.S.S.), and 12 (P.N.T.C.C.S.S.) – their mean value for each academic year yields adequate information on the presence of relevant compulsory subjects within an undergraduate program, while taking into account the total number of compulsory subjects, as well as the number of teaching credits associated with the chosen main athletic subject [1,2,3,4]. All three criteria in the above example belong to the primary group [1,2,3,4]. (All the relevant Mean Value Diagrams of the three Criteria 3, 6, 12, referred to in this study, are available upon request by the corresponding author.)

As an indication, we present: 1) Figure 2: The mean values of the three criteria (3, 6, 12) for athletic subject 11 (Music and Movement Education) at DPESS in Thessaloniki (AUTH), between 1983 and 2008 [1], 2) Figure 3: The mean values of the three criteria (3, 6, 12)

for athletic subject 4 (Classical Athletics) at DPESS in Thessaloniki (AUTH), between 1983 and 2008 [1].

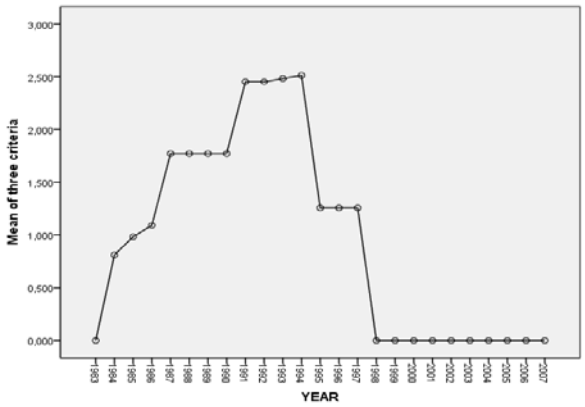


Figure 2. The mean values of the three criteria (3, 6, 12) for athletic subject 11 (Music and Movement Education) at DPESS in Thessaloniki (AUTH), between 1983 and 2008 [1]

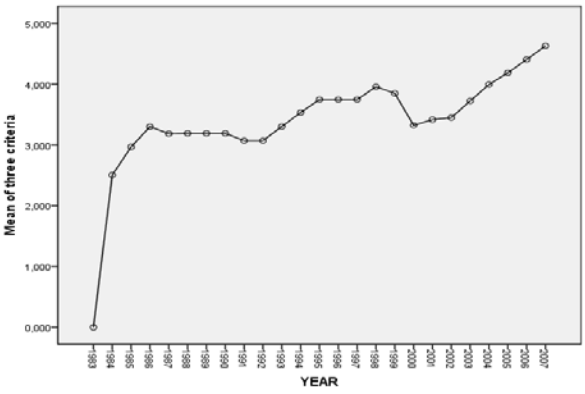


Figure 3. The mean values of the three criteria (3, 6, 12) for athletic subject 4 (Classical Athletics) at DPESS in Thessaloniki (AUTH), between 1983 and 2008 [1]

One additional criterion of the same group, which adequately informed us about the PE teacher education on a chosen main athletic subject, is 1 (N.S.S.) [1,2,3,4]. Regardless of the sub-subjects' category, i.e. whether they are Compulsory (C.), Compulsory Elective (C.E.), Optional (O.), Main Core (M.C.), Path (P.) or Specialization (SP.), the value for 1 (N.S.S.), in other words the total number of different sub-subjects relevant to a main athletic subject within a department's undergraduate program, indicated the department's staff and students' educational interest towards that main athletic subject [1,2,3,4].

The MDS-T solutions for all departments and for each department individually (for the years of operation that coincide with the research scope) revealed a similar educational interest and strategy for PE teacher education in nearly all thirteen (13) main athletic subjects: the results showed that only 10, 11 and 12 (Psychomotor Education, Music and Movement Education and Games) were treated differently compared to the rest. The MDS-T solutions showed that this observation was consistent in all departments, with the exception of Komotini: although 10, 11, and 12 also diverged from the general educational strategy followed in the remaining main athletic subjects, the difference was less significant than the one observed in the other departments [1,2,3,4].

5.3. Selected Criteria and/or Groups of Selected Criteria of the Criteria-based Matrix

Eventually, the above analysis revealed that in their years of operation the five departments examined overall emphasized the main athletic subjects 4, 5, 6, 1, 8, 7, and 13 (Classical Athletic, Basketball, Volleyball, Gymnastics, Football, Handball, and Swimming) in their undergraduate programs. Contrastingly, as the mean values of criteria 3 (N.C.S.S.), 6 (P.C.S.S.), 12 (P.N.T.C.C.S.S.), and 1 (N.S.S.) indicate, main athletic subjects 12, 10, and 11 (Games, Psychomotor Education, Music and Movement Education) were not adequately covered [1,2,3,4].

As an indication, we present: 1) Figure 4: The mean values of the three criteria (3, 6, 12) for athletic subject 11 (Music and Movement Education) at DPESS in Athens (NKUA), between 1983 and 2008 [1], 2) Figure 5: The mean values of the three criteria (3, 6, 12) for athletic subject 4 (Classical Athletics) at DPESS in Athens (NKUA), between 1983 and 2008 [1]

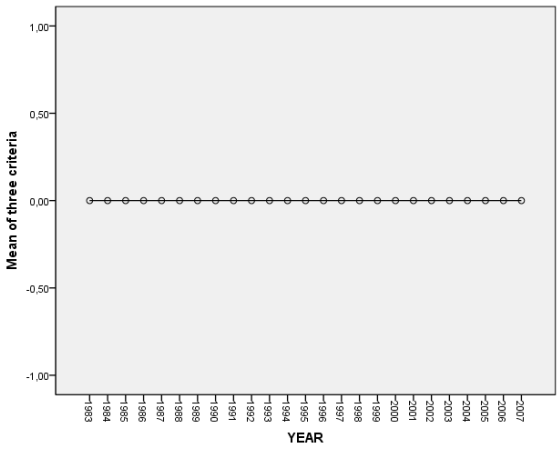


Figure 4. The mean values of the three criteria (3, 6, 12) for athletic subject 11 (Music and Movement Education) at DPESS in Athens (NKUA), between 1983 and 2008 [1]

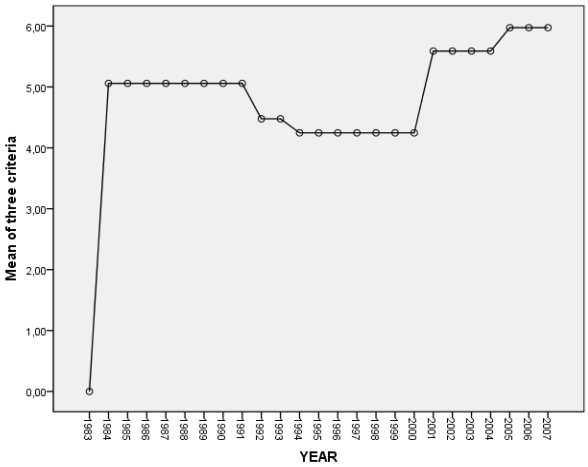


Figure 5. The mean values of the three criteria (3, 6, 12) for athletic subject 4 (Classical Athletics) at DPESS in Athens (NKUA), between 1983 and 2008 [1]

6. Conclusions and Suggestions

Regarding the use of the evaluation criteria-based process for other related aims of researches, about similar issues of Higher Education, in the future: One of the main reasons for this article was questions by other researchers (who studied our previous specific research) with the aim of 'requesting' clarifications and any other necessary feedback, in order to apply the criteria-based tool in other relevant researches, regarding similar issues between the same or different scientific discipline Departments in HEIs.

Our basic guidelines are therefore summarized as follows: after setting the purpose of the research and having as a basis the methodology and limitations as mentioned in section 2, we should definitely study all the theoretical framework/bibliography related to the research.

We then proceed to select the criteria from this criteria-based tool. With corresponding documentation, the criteria could be fewer, or more with the addition of other ones. In any case, this criteria-based set constitutes a well-documented theoretical, but also practical "guide", based on which other criteria and/or groups of criteria can be created, with the aim of their specialized use in other related research.

After recording all the data that will be generated, the next decision we will have to make is how we will perform the necessary statistical analysis. The first decision is that obviously - after recording them - the mean values of selected criteria should be studied. Then, regarding the set of recorded data we should use a Multivariate Analysis. The known possibilities of the statistical analysis of data with the use of the Multidimensional Scaling Trigonometric Solutions on the circle and/or the sphere (MDS-T) [31] could guide us to this choice [1]. Based on the MDS-T, conclusions could be drawn not only from the measurements based on the selected criteria, but also in terms of the criteria themselves. However, this choice of ours does not preclude the fact that other researchers for similar Higher Education issues could choose and use some other Multivariate Analysis.

Based on the results and possibilities of the Multivariate Analysis which we have decided upon, we can be finally guided as to the choice of study of any of the criteria we used and/or groups of selected criteria.

Although it is known that the adaptation of an existing process/tool to suit another culture can be a strenuous and ongoing procedure, researchers are encouraged to use the process of this study in other national educational systems, and for other related aims regarding Higher Education - after applying appropriate amendments or adjustments [1,2,3,4].

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