Evaluation of European educational systems with the method of the Analytic Hierarchy Process (AHP): Promotion of good practices for the Greek educational system

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Abstract

This project evaluates six European high-performance educational systems, using the Analytic Hierarchy Process (AHP) method (Saaty, 1980). The evaluation was applied to critical educational indicators that cover and are based on the four aspects of the Balanced Scorecard (BSC) method and resulted in the ranking of educational systems from best to worst per criterion, per aspect and as a whole. The prioritization of the criteria was guided by the respective characteristics and performance of the Greek educational system. It is a fact that the transplantation of an educational system as a whole from one country to another is not thriving. On the contrary, separately adopting good practices that have been applied to educational systems of other countries have been observed to be successful. Through this process, there was an emersion of good practices that can be proposals for implementation in education in Greece, after of course undergoing the appropriate adjustments.

Keywords: European educational systems, analytic hierarchy process, evaluation of educational systems, good practices in education

Introduction

The Greek educational system, lacking any form of organized and systematic evaluation of its work during the last forty years, presents low performance and rankings in international comparisons and at the same time gathers negative social reviews and low levels of satisfaction from the entire educational world, teachers, parents and students. The economic and social crisis that has plagued Greek society and its educational system over the past decade has caused organizations within the country, such as the Authority for Quality Assurance in Primary and Secondary Education (AQAPSE), as well as outside it, such as the European Commission (EC) and the Organization for Economic Co-operation and Development (OECD) to raise their voices and make clear that a purposeful educational reform is now needed to help the country emerge from the current crisis and shield itself against future ones. The findings are worrying since the latest results of the performance of Greek students, both from the PISA 2018 (OECD, 2019) but also from the report of AQAPSE for 2019 (Matsagouras et al., 2019), warn of functional illiteracy of today's Greek students and tomorrow's citizens, in percentages up to almost 40%, depending on the class of students. Many European countries base their social and economic well-being on their educational systems, which have features worth studying. The case of Finland, which after a severe economic crisis (1990-1993), invested in the reform and improvement of its educational system and then used it as a main way out of it, achieving remarkable levels of economic and social development, can be considered exemplary. The case of the Czech Republic is also noteworthy: it started only three decades ago, from very low social, economic and educational starting points, but immediately invested in its educational system, presenting impressive performance in its course to date.

The main purpose of this project is the development and implementation of a practical and reliable model of multilevel and multi-criteria evaluation of educational systems in their entire operation, including even the built-in mechanism that they have in order to be evaluated internally. Through this process and with the use of the AHP method, the effect that the

individual indicators have in shaping the result of the evaluation of applied educational systems was investigated. The aim of this investigation was to highlight good practices that could help the Greek educational system if they were incorporated into it. Using AHP, a realistic model of comparison and ranking of the selected European educational systems was created. This model consists of the repeated binary comparison of eleven critical educational indicators and their characteristics, which are mostly quantitative. These criteria were distributed and they covered the four aspects of the BSC strategy method: the financial aspect, the beneficiary aspect (students in this case), the learning and development aspect and the internal processes aspect. The data that were used in the comparison process were drawn from the archives of supranational organizations such as Eurostat, OECD, EC, and educational networks such as Eurydice. The fact that "knowledge" is an indicator of economic, political, cultural and technological power encourages international organizations to be more and more interested in education and educational policy (Athanassoula-Reppa, 2008). In addition, with the expansion of the globalized market, states are increasingly trading with supranational organizations regarding the shaping and the implementation of their educational policy. For their part, the international and regional organizations, in their reform proposals for education, state that the evaluation of the educational work should be a priority and a condition and that it is essential for the educational systems to report to the societies.

Evaluation of the educational systems

Regarding the great matter of evaluation in education, a number of approaches, theories and interpretations have been formulated, depending on the aspects evaluation itself deals with, what and who exactly is being evaluated, who and when will implement it, how and by whom its results will be used, what effects it will have and who is going to suffer the consequences, etc. "By 'evaluation', we understand a general process of systematic and critical analysis of a defined subject that includes the collection of relevant data and leads to judgments and/or recommendations for improvement. The evaluation can focus on various subjects: schools, school heads, teachers and other educational staff, programs, local authorities, or the performance of the whole educational system" (Eurydice, 2015). A prerequisite for the smooth operation of a system with functional terms of efficiency and effectiveness is its evaluation (Rossi et al, 2018). The basic principle for the necessity of evaluation is that evaluation itself should function as a feedback tool of the educational system as a whole in order to increase the efficiency of educational services (Athanassoula-Reppa, 2008). It is a fact that from country to country significant differences are identified in the assessment systems they apply to their educational systems, but at the same time several points of convergence have been observed during the last decades. For example, five out of the six countries studied in this paper use the school inspection system for the external evaluation of their schools. Two new features that have been incorporated in most modern education evaluation systems during the last decades, are the holistic approach to school operation (Creemers, 1994) with multilevel effects of the various factors on student performance (Kyriakides, 2008) and the application of the school units' self-assessment. (MacBeath, 1999). The common tactic followed in the evaluation of the educational project is the evaluation of the criteria from all the fields of the educational process and not focusing on the evaluation of only some factors of the educational process, such as the teacher. This makes the AHP method an ideal evaluation method for educational systems. Even school self-assessment reports, which are based on the assessment of the educational process's fields and criteria, can be modeled using the AHP method and constitute the starting point and the main pillar in the process.

The Analytic Hierarchy Process – AHP

The Analytic Hierarchy Process was developed in the 1970s by Thomas L. Saaty. AHP is a method based on Mathematics and Psychology. For any problem that requires a decision in

order to be solved, AHP does not make the right decision in the strict sense of the term, but the decision that best suits the priorities and psychology of those responsible for that decision. Initially the main problem, the solution of which is the goal, is deconstructed into sub-problems or criteria which are hierarchically inferior and each of them can be understood and analyzed more easily. The process can be repeated at another lower level, analyzing each criterion into sub-criteria. This creates the hierarchy that includes elements that may be qualitative or quantitative, the values of which may be precise or estimated, objectively or subjectively. These elements are evaluated (compared) in pairs depending on their effect on the immediately hierarchically superior element. A priority, in the form of a numerical weight, is assigned to each element by the decision maker or by the team of managers.
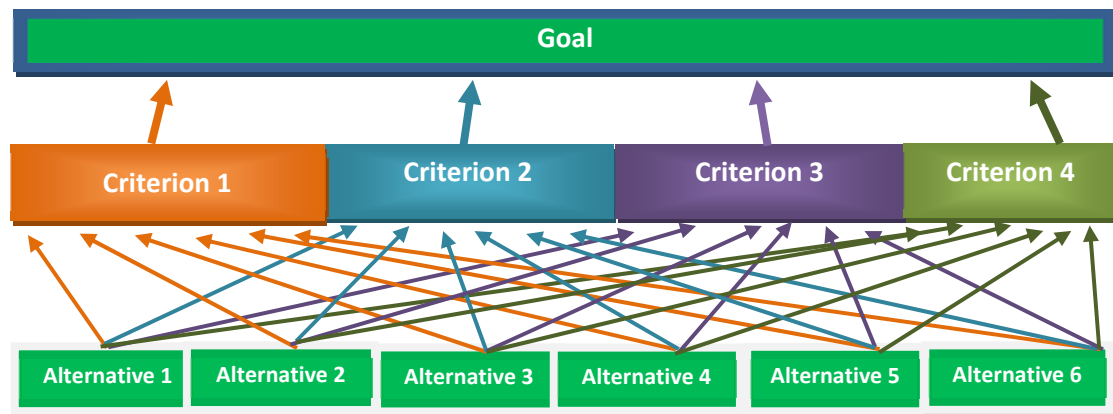

Figure 1. General structure of Analytic Hierarchy Process

The priority of each element is based on the incoming information about it while also incorporating the subjectivity of the decision maker to some extent. This is the point where the value of the method is highlighted: the decision that will be approved, the classification of alternatives that will be formed, is the one that is harmonized with the priorities and values of the decision maker. The binary comparison is made on a scale of nine points that starts from 1, which indicates the equality of participation of the two criteria in achieving the goal and gradually ends to 9, which indicates the very strong superiority of one criterion over the other in achieving the target, as described in Table 1.

Table 1. 9–point intensity of relative importance scale (Saaty & Kearns, 1985)

Intensity of relative importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance of one over another	Experience and judgment slightly favor one activity over another
5	Essential or strong importance	Experience and judgment strongly favor one activity over another
7	Demonstrated importance	An activity is strongly favored and its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation

| 2,4,6,8 | Intermediate values between the two adjacent judgments | When a compromise is needed |
| Reciprocals of the above nonzero numbers | Reciprocal for inverse comparison | |

The process is repeated for all the elements of the level, which are always evaluated in pairs, and is completed at all levels. For this purpose, a table of comparisons of n criteria, i.e., dimension n, is compiled at each level. The AHP method has a built-in mechanism of consistency of the decisions made during the process, the consistency ratio CR (Consistency Ratio) which must have values less than 0.1. The ratio for consistency is given by the formula:

$$CR = \frac{CI}{RI}$$

Where CI (Consistency Index) is the consistency index given by the formula:

$$CI = \frac{\lambda max - n}{n - 1}$$

Where n is the array dimension, λmax is the largest eigenvalue and RI (Random Consistency Index) is the average consistency index of randomly generated binary comparison tables. It is a fixed number for every n, according to Table 2.

Table 2. Random inconsistency indices (RI) for n=10 (Saaty, 1980)

n	1	2	3	4	5	6	7	8	9	10
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49

Application of the AHP method to the evaluation of European educational systems

The educational systems of six European countries were selected, studied and evaluated. Their selection was based on criteria of representativeness in terms of educational structures and it was made among countries that have high critical educational indicators. Countries with centralized educational systems such as France, Germany and Austria were selected, as well as countries with decentralized systems of different forms, such as the educational system of the Czech Republic, which is decentralized when it comes to the institution of the school principal, the Finnish educational system, which is highly decentralized, and the Dutch educational system, which is more technocratic. The criterion for the characterization of educational systems is the value of the index of school autonomy, as it results from the relevant research of the OECD. This value is the percentage of important decisions made at the local level, i.e., by the various forms of local school boards, by the principal or even the teachers. Specifically, the values above the OECD average, which is 71.3% (i.e., two of the three important decisions for schools, are taken at a local level) characterize an educational system as decentralized, while the values below this number characterize it as centralized. The structure of the AHP was implemented in two levels of criteria, as shown in Figure 2. The criteria and sub-criteria were supplied on a case-by-case basis with information and values that were drawn from Eurostat files, the E.U. of the O.E.C.D. files, the educational network Eurydice files, etc. The AHP method has the flexibility and the ability to be enriched with a number of criteria for evaluation, and thus it is chosen as ideal for the evaluation of educational systems as a whole. In addition, the assignment of priorities to each criterion by the decision-making team, provides the opportunity to make it dynamically adapted to each educational, pedagogical and political perception.
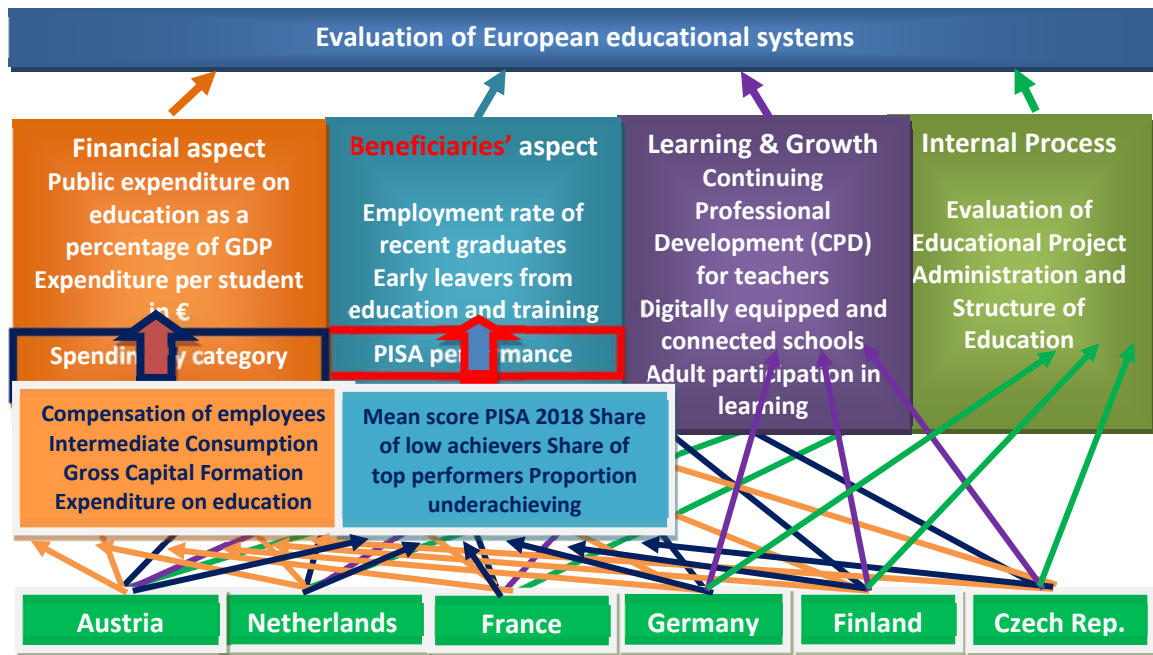
Figure 2. The implementation of AHP in the evaluation of European educational systems

Financial aspect

Table 3 lists the values of the criteria by which the educational systems are evaluated regarding the financial aspect, at two levels, as shown in Figure 2. This was done because the funding of education for each country is evaluated by taking into consideration not only its amount, but also its distribution, which indicates the priorities of the education policy pursued by each country. Initially, the evaluation was based on the spending by category criterion, with comparisons in the sub-criteria: employee compensation (mainly teacher pay), intermediate consumption, i.e., expenses for teaching materials, heating and electricity, etc., gross capital formation, i.e., investments of equipment such as computers, construction of new buildings, etc. and expenditure on education (% of total government expenditure).

Table 3. Financial aspect. Source: Eurostat [gov_10a_exp], [educ_uoe_fine09]

Criterion	AT	NL	FR	DE	FI	CZ	E.U. 28
Public expenditure on education (%GDP)	4.8%	5.1%	5.1%	4.2%	5.5%	4.6%	4.7%
Expenditure per student in €	11,761	9,733	8,119	9,190	10,109	3,508	
Compensation of employees (%GDP)	3.1%	2.9%	3.7%	2.4%	2.7%	2.9%	2.9%
Intermediate consumption (%GDP)	0.8%	1.1%	0.4%	0.6%	1.3%	0.8%	0.7%
Gross capital formation (%GDP)	0.3%	0.5%	0.3%	0.3%	0.8%	0.7%	0.3%
Expenditure on education (% of total government expenditure)	9.8%	12.1%	9.1%	9.4%	10.4%	11.4%	10.2%

The data in Table 3 refer to the year 2018, with the exception of the expenditure per student in € which concerns the year 2017 at ISCED levels 1-8 (excluding pre-school education).

The results of the AHP method classify the educational systems of the forenamed countries, in the criterion spending by category, as shown in Figure 3.
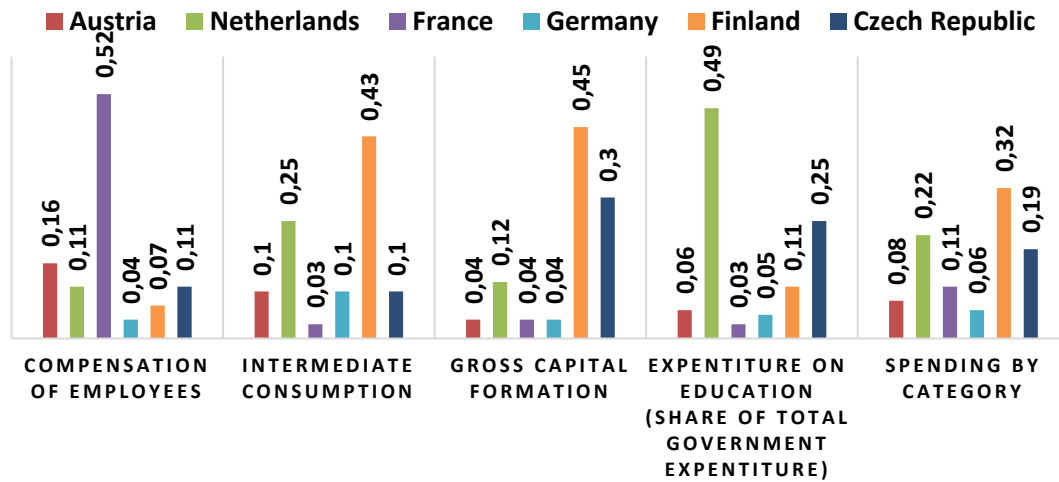

Figure 3. Expenditure on education by category

The CR values of the criteria in all of the following tables are less than 0.1, therefore they are acceptable.

Table 4 lists the CR values and the priorities given to the criteria that compose the spending by category criterion.

Table 4. Spending by category, consistency ratio and priorities

Criterion	Priorities	Consistency Ratio
Compensation of employees	0.17	0.012
Intermediate consumption	0.33	0.014
Gross capital formation	0.33	0.014
Expenditure on education	0.17	0.032

Table 5 lists the CR values and the priorities given to the criteria that make up the financial aspect.

Table 5. Financial aspect, consistency ratio and priorities

Criterion	Priorities	Consistency Ratio
Public expenditure on education	0.40	0.014
Expenditure per student in €	0.20	0.008
Spending by category	0.40	0.017

The results of the AHP method classify the educational systems of the forenamed countries, regarding the financial aspect, as shown in Figure 4.
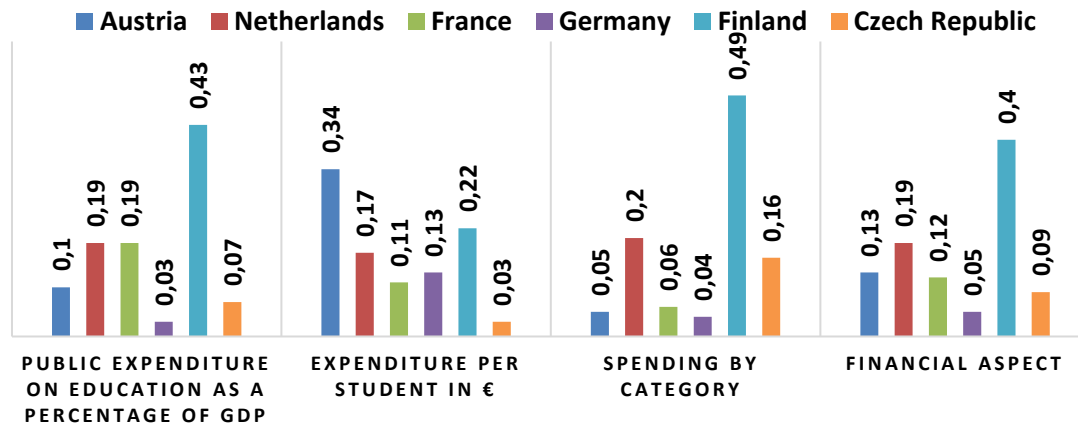
Figure 4. Financial aspect

Beneficiaries' aspect

The aspect of the beneficiaries, in our case the students, is also evaluated in two levels as shown in Figure 2. The values of the assessed criteria are shown in Table 6. The first level concerns exclusively the performance of the students in the PISA. In order for it to be evaluated, data were extracted from the relevant OECD files.

Table 6. Beneficiaries' aspect. Source: Eurostat [sdg_04_50] [edat_lfse_16], OECD

Criterion	AT	NL	FR	DE	FI	CZ	E.U. 28 /O.E.C.D
Employment rate of recent graduates	88.6%	92%	77.9%	92.1%	81.7%	89.6%	81.6%
Early leavers from education	7.3%	7.3%	8.7%	10.3%	8.3%	6.2%	10.5%
Mean score PISA. 2018	491	502	494	500	516	495	488
Underachieving in Reading, Math's and Science (Average)	21.7%	17.8%	22.4%	16.8%	12%	21.5%	20.8%
Top performers in at least one subject	15.7%	21.8%	15.9%	19.1%	21%	16.6%	15.7%
Low achievers in all three subjects	13.5%	10.8%	12.5%	12.8%	7%	10.5%	13.4%

Table 7 lists the CR values and the priorities given to the criteria.

Table 7. PISA performance, consistency ratio and priorities

Criterion	Priorities	Consistency Ratio
Mean score PISA. 2018	0.25	0.010
Underachieving in Reading, Math's and Science (Aver.)	0.12	0.019
Low achievers in all three subjects	0.13	0.016
Top performers in at least one subject	0.50	0.016

The criterion "Underachieving in Reading, Math's and Science (Average)", derives from the performance of students in PISA 2015, while the criteria "Mean score PISA.", "Top performers in at least one subject" and "Low achievers in all three subjects" result from the students' performance in PISA. 2018, so that there is a comparative connection between the

competitions. The values of the "Employment rate of recent graduates" and "Early leavers from education" criteria refer to the year 2018 (Eurostat, 2018). The results of the AHP method classify the educational systems of the forenamed countries, in the PISA performance criterion, as shown in Figure 5.
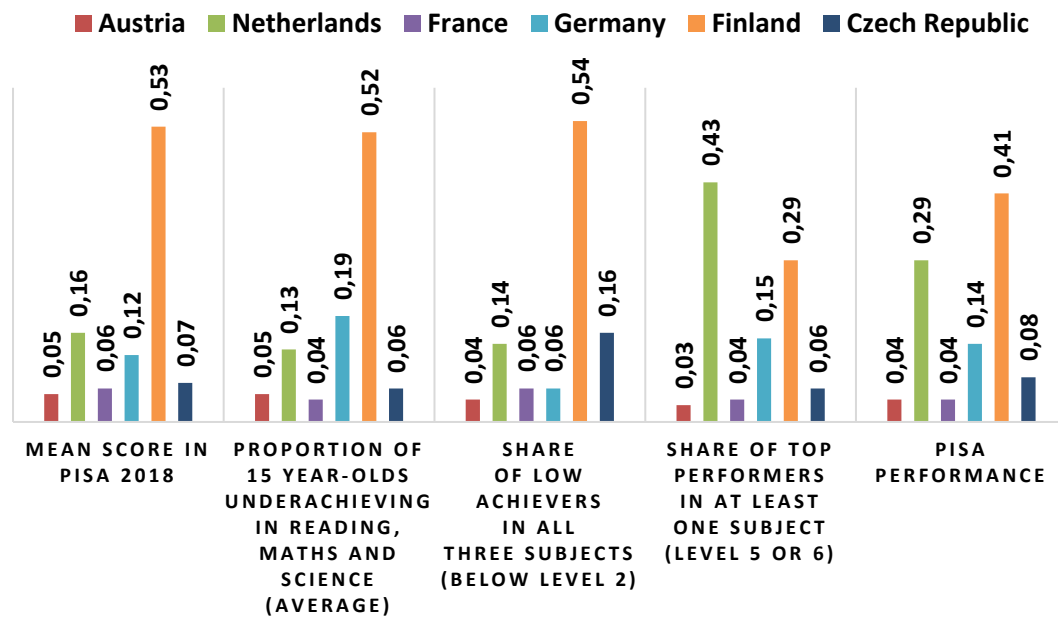

Figure 5. PISA performance

The results of the AHP method classify the educational systems of the forenamed countries, regarding the beneficiaries' aspect, as shown in Figure 6.
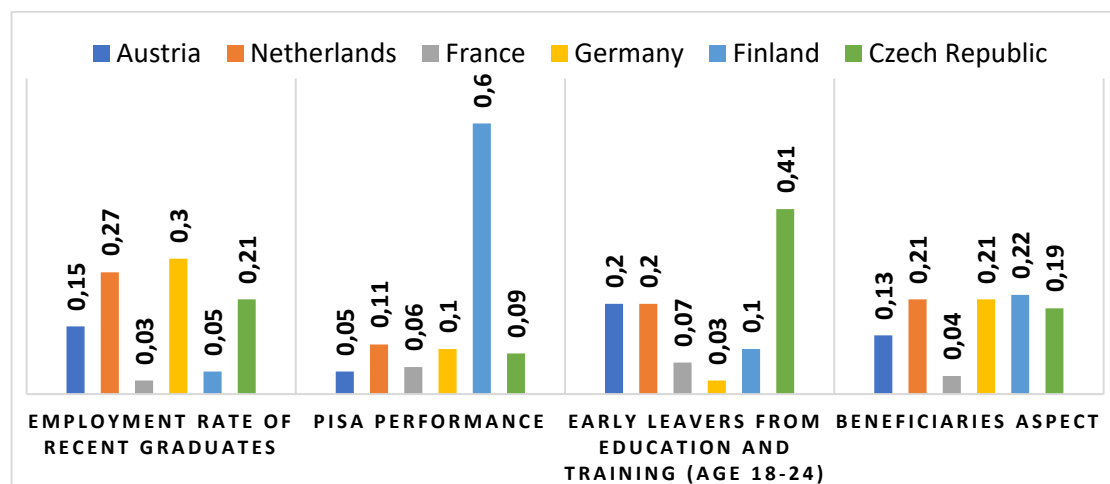

Figure 6. Beneficiaries' aspect

Table 8 lists the CR values and the priorities given to the criteria that make up the beneficiaries' aspect.

Table 8. Beneficiaries' aspect, consistency ratio and priorities

Criterion	Priorities	Consistency Ratio
Employment rate of recent graduates	0.60	0.011
PISA performance	0.30	0.016
Early leavers from education	0.10	0.013

Learning and growth

The learning and growth aspect includes the evaluation of the six educational systems by using the criterion "Continuing Professional Development (CPD) for teachers", as shown in Table 9. The CPD status in each country, whether it is mandatory, professional duty, required for promotion or salary progression or optional, as well as the status of induction programs, whether it is compulsory, recommended or not regulated (Eurydice, 2018), were taken into consideration.

Table 9. Learning and growth. Source: Eurydice, E.U., Eurostat [trng_lfse_04]

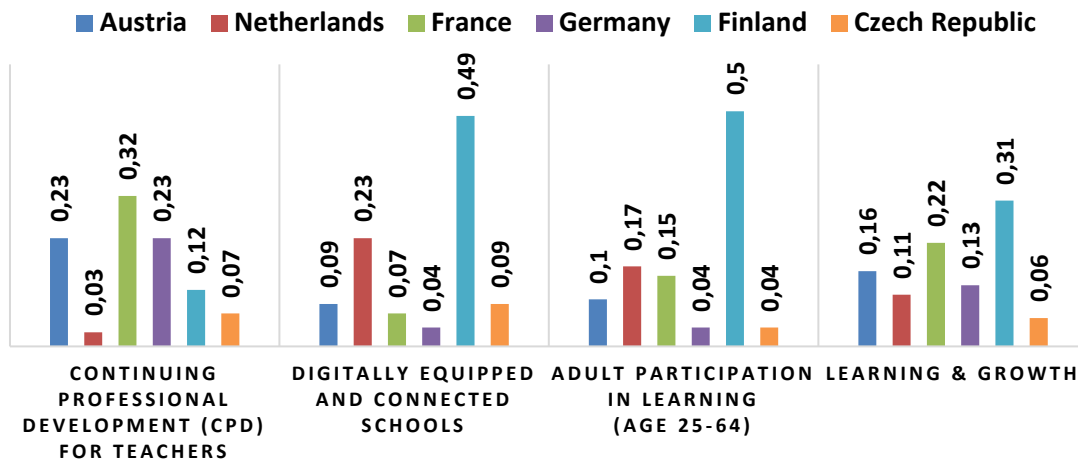| Criterion	AT	NL	FR	DE	FI	CZ	E.U. 28
Continuing Professional Development (CPD) for teachers	80%	40%	85%	80%	70%	60%	
Digitally equipped and connected schools	56.3%	74.3%	49%	36.3%	93.7%	56.3%	53%
Adult participation in learning	15.1%	19.1%	18.6%	8.2%	28.5%	8.5%	20.8%

Figure 7. Learning and growth

For the criterion "Digitally equipped and connected schools", a percentage of highly digitally equipped and connected schools was assessed. These schools have (among other features) a high provision of digital equipment (laptops, computers, cameras, whiteboards) per number of students and a high broadband speed in ISCED levels 1 to 3 (EC, 2019). Table 9 also shows the percentages of adults between the ages of 25 and 64, graduates of all levels of education, who participated in 2018 in some form of education or training in structures of formal or informal education. The final ranking of the educational systems of the six countries in the learning and growth aspect is shown in Figure 7.

Table 10 lists the CR values and the priorities given to the criteria that make up the learning and growth aspect.

Table 10. Learning and growth, consistency ratio and priorities

Criterion	Priorities	Consistency Ratio
Continuing Professional Development (CPD)	0.50	0.012
Digitally equipped and connected schools	0.25	0.014
Adult participation in learning	0.25	0.013

The final ranking

The final ranking of the six European educational systems was derived from their overall evaluation in a total of four aspects of the BSC, which were given priorities as shown in Table 11. For the internal process aspect in particular, the status of the external evaluation criterion (whether it is carried out as a piloting phase or there is no external school evaluation), the typology of outcomes following the external school evaluation report (whether this is remedial actions, disciplinary actions, or profile-raising actions) and the distribution of the external evaluation report of simple schools (whether the reports are made public, are distributed with restrictions or distributed to outside parties) were taken into account (Eurydice, 2015). In addition, for the evaluation of the internal process aspect, the structure and the number of educational paths offered by each educational system, especially in the upper secondary education, was taken into consideration (Eurydice, 2018). The ranking of the six educational systems into the four aspects of the BSC method as well as their overall ranking are shown in Figure 8.
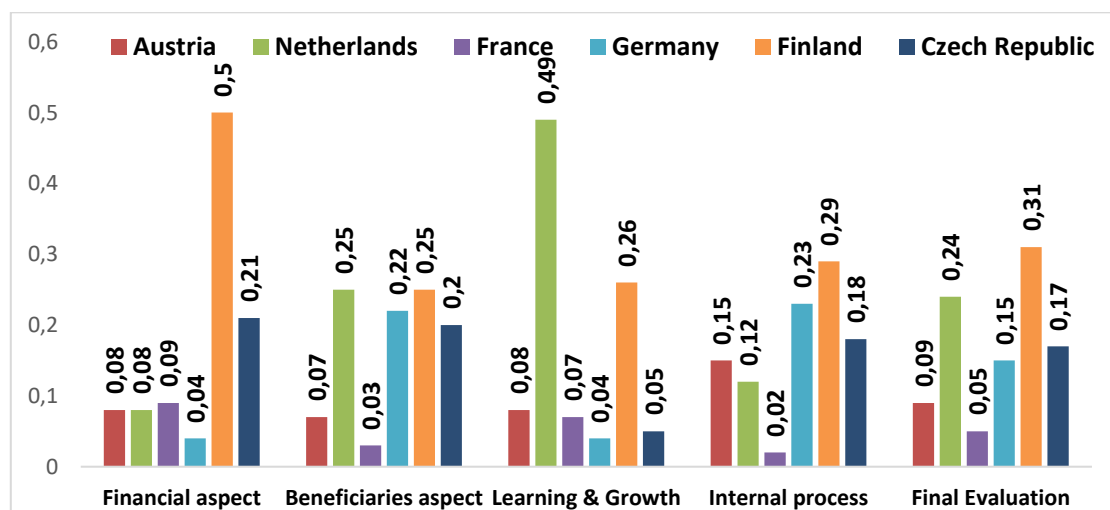

Figure 8. Final assessment ranking of educational systems

Table 11 lists the CR values and the priorities assigned to the four aspects.

Table 11. Final ranking criteria, consistency ratio and priorities

Criterion	Priorities	Consistency Ratio
Financial aspect	0.20	0.014
Beneficiaries' aspect	0.40	0.016
Learning and growth	0.20	0.014
Internal Process	0.20	0.007

Conclusions

The application of the AHP method led to the ranking of the six European educational systems and, at the same time, it highlighted good practices that are worth studying and that they could be applied in the Greek educational system, after being adapted. The most important practices are the following:

Decentralization of the Greek educational system. The result of the final evaluation, from Figure 8, of the six European educational systems is that the decentralized educational systems of the study, the Finnish, the Dutch and the Czech Republic's (in this order), ranked in comparatively better positions than the centralized ones. Besides, the Greek educational

system is too centralized (OECD, 2016) since the value of the school autonomy index ranks it last among the other OECD countries.

The countries of which the educational system has strong connections with the labor market and at the same time their students achieve high ranking at international contests (PISA) presents high ranking at the beneficiary aspect, too.

The funding and infrastructures of the Greek educational system. It is no coincidence that the Finnish educational system, which was selected as the best after the evaluation, has the highest funding, as results from financial aspect, of all the six educational systems that were compared. An educational system with low-paid teachers who teach using incomplete and outdated infrastructure and outdated educational material, in unsuitable buildings that do not meet the educational needs when it comes to space, heating, etc. cannot produce quality output. The Greek educational system is heavily underfunded (Eurostat, 2018).

Upgrading the role of the teacher. All the countries that want to upgrade their educational system seem to have realized that upgrading the role of teachers is required, as results from learning and growth aspect. A typical example is seen in Finland, where the social status and prestige that the state has given to the teachers' profession has been able to upgrade the quality of the educational work, to inactivate and minimize the need to use inspection structures and to establish the Finnish educational system as a European standard (Eurydice, 2021).

Evaluation of the Greek educational system. Each and every educational system that was evaluated has mechanisms for assessing the educational work it produces (Eurydice, 2018). The Greek educational system operates without knowing the results it has produced for the last forty years and with the complete absence of a feedback mechanism. Also, it does not present a comprehensive strategy for achieving any goals. It seems that in most countries it has been understood that evaluation is the key tool that will ensure and improve the quality of the educational work, as results from internal processes. "Quality assurance in education can be understood as policies, procedures, and practices that are designed to achieve, maintain or enhance quality in specific areas, and that rely on an evaluation process" (European Commission, 2015).

Conducting a survey regarding the teachers' attitude towards the conclusions stated above as well as their opinions about them would be very interesting. Such a survey would assist the selection and the adjustment of the AHP method's priorities

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