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Towards a new approach to the calculation of higher education indicators

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Abstract
In this article, we will present a new approach to calculating higher education indicators (LMD system), based on the modules and not on semesters or years of study.
In the first step, we will adapt the indicators to our new approach, then we will compare the results obtained with those of the semester-based approach.
The tests are carried out on three cohorts (2007, 2008, and 2009) of the Faculty of Economics, Law and Social Sciences - Soussi, Rabat. The results obtained are relevant and show the importance of our modular approach.

Keywords: LMD system, indicators, semi-annual approach, modular approach

1. Introduction

The Kingdom of Morocco is at a decisive juncture in its development, facing both internal and external changes. Facing the challenges of globalization, Morocco must adapt to international transformations while accelerating and reinforcing the various political, economic and social development projects, within the framework of the National Human Development Initiative (NHRI) launched in May 2005 which constitutes today the cornerstone and the framework for the human development process in Morocco (Sobhi Tawil, Sophie Cerbelle, Amapola Alama, 2010) [14].

In this regard, the higher education sector has undergone real development and progress over the last few years [5]. In 2003-2004, the Moroccan university has experienced the entry into force of the new University Reform (LMD) [6, 12].

This reform puts the Moroccan university under pressure with the objective of evaluating and quantifying its performance [8].

Thus, any evaluation requires a set of measuring tools and a set of indicators. Therefore, since the LMD reform has made new changes and improvements against the old system, the need to create a new set of indicators and adapt them to the new system is of primordial importance.

In this article, we will present a new approach to calculating indicators, according to the modules, and then make a comparison between this new approach and the approach by semester.

To highlight our methods, we should point out that we have worked on 3 cohorts (2007, 2008, 2009) within the Faculty of Economics, Law, and Social Sciences Souissi-Rabat at the University Mohamed V, Rabat, Morocco, in order to interpret the results obtained, and to compare the different indicators according to the two approaches.

We note afterwards

$D_{g,j}$: Number of graduates in cohort g after j semesters of studies

$A_{g,j}$: Number of students (cohort g) dropping after j semesters of studies

D_g: Number of g cohort graduates

J: Number of semesters of study.

G: Student cohort

K: The number of repetitions allowed

n : Normal number of training modules
(In the case of Morocco n = 6)

m_j : Sum of the entries in each module of each student after j semesters of study.

m : Normal number of training modules.
(In the case of Morocco m = 24)

2. Indicators of effectiveness by the semester approach

- **Number of student-semesters:** it allows to calculate how much each graduate costs in terms of semesters for his training. It is defined as the sum of the semesters spent by each student in training until graduation or dropping without a diploma [4].

$$NS_{dip} = \frac{\sum_{j=n}^{n+k} D_{g,j} \times j + \sum_{j=1}^{n+k} A_{g,j} \times j}{D_g} \qquad (1)$$

- **The number of actual semesters consumed by a graduate:** This is the actual number of semesters needed to train graduates of a g cohort.

$$NS_{réels} = \frac{\sum_{j=n}^{n+k} D_{g,j} \times j}{D_g} \qquad (2)$$

- **Efficiency coefficient (CE_s):** "*The ideal (optimal) number of pupil-years required (i.e. in the absence of repetition and dropout) to produce a number of graduates from a given school-cohort for a cycle or level of education expressed as a percentage of the*

actual number of pupil-years spent to produce the same number of graduates. Input-output ratio, which is the reciprocal of the coefficient of efficiency, is often used as an alternative." [3]

A simple adaptation of this indicator is to replace the number of student-years by the number of student-semesters, then the following formula is obtained [2]:

$$CE_s = \frac{\sum_{j=n}^{n+k} D_{g,j} \times j}{\sum_{j=n}^{n+k} D_{g,j} \times j + \sum_{j=1}^{n+k} A_{g,j} \times j} \times 100 \quad (3)$$

In this case, the wastage coefficient is given by [2]:

$$CD_{sg} = \frac{1}{CEs_g} \times 100 \quad (4)$$

Since the module is considered to be the main unit for the LMD system, one can go further and define or adapt the previous semester-based indicators, to indicators based, in their calculation, on the modules, in order to obtain a vision and analysis following a modular approach, for the following reasons:

- A student who has consumed a number of student-semesters does not mean that he has consumed all the modules of the semesters consumed.
- A student can consume less than four modules during a given semester; (Note that each semester consists of four modules in the normal case of Morocco).

This makes these indicators based on the notion of semester, less accurate and less reliable, and therefore the loss of a lot of information during the reading of the results of these indicators.

So, and for these reasons we will redefine in the following all the indicators already presented, and that are based this time on the number of modules.

3. Indicators of efficiency by the modular approach

- **The number of student-modules:** This is the sum of the entries made in each module by each student of the training until graduation or abandonment without diploma. It is given by the following formula [1]:

$$NM_{dip} = \frac{\sum_{j=n}^{n+k} D_{g,j} \times m_j + \sum_{j=1}^{n+k} A_{g,j} \times m_j}{D_g} \quad (5)$$

- **The number of actual modules consumed by a graduate:** This is the sum of the entries made in each module by each graduate of the training.

$$NM_{réel} = \frac{\sum_{j=n}^{n+k} D_{g,j} \times m_j}{D_g} \quad (6)$$

- **Efficiency coefficient (CE_m):** To address the problem of the reliability of the semi-annual efficiency coefficient, an improvement is proposed by the following formula [1]:

$$CE_m = \frac{\sum_{j=n}^{n+k} D_{g,j} \times m}{\sum_{j=n}^{n+k} D_{g,j} \times m_j + \sum_{j=1}^{n+k} A_{g,j} \times m_j} \times 100 \quad (7)$$

- In this case, the **wastage coefficient** is given by:

$$CD_m = \frac{1}{CE_m} \times 100 \quad (8)$$

4. The ability to validate a cohort in number of modules per semester (CV_g)

A new indicator is proposed here, which is a synthetic indicator linking the modular and semi-annual approach at the same time, and which allows to link the efficiency and efficiency of such training. It is about measuring on average the number of modules consumed per semester to form a graduate.

It can also be interpreted as the speed of completion of studies for a graduate.

So, it is the ratio between the number of student-modules and the number of student-semesters.

It is given by the following formula:

$$CV_g = \frac{NM_{dip}}{NS_{dip}} \quad (9)$$

This indicator is strictly greater than 0 (case of inefficiency and total inefficiency), and can exceed 4 (ideal case = 4), because of the 5th module allowed per semester, and also depends on the authorized number of redoubling.

In the ideal case this number equals 4, because the number of student-modules ideal for graduation is 24, and the number of student-semesters ideal for graduation is 6.

If this number is equal to 3 for example, it means that there is an overload of modules per semester, so normally one has to think about reducing the number of modules per semester of 4 modules to 3 modules, to make the training more efficient and more efficient at the same time.

5. Comparison between the biannual approach and the modular approach, case of the Faculty of Legal, Economic and social Sciences-Segovia, Rabat

In the following we will try to apply these different indicators on a real student basis, containing the cohorts of students from the years 2007, 2008, and 2009 successively, from the Faculty of Economics, Law, and Social Sciences Souissi-Rabat, University Mohamed V, Rabat, Morocco. And then compare, and follow the progression of the LMD system for the 3 cohorts, following the two approaches that we defined earlier.

To calculate these indicators for both approaches, we developed an application under SQL Server. The results obtained are presented in the following table:

Table 1: Indicators for measuring the effectiveness of fsjes-Souissi for Cohorts (2007, 2008, and 2009)

Indicators \ Cohorts		2007	2008	2009
semi-annual approach	Number of student-semesters	16,77	14,28	14,66
	The number of actual semesters consumed by a graduate	9,33	9,13	8,8
	Efficiency coefficient (CE_s)(en %)	35,78	42,01	40,91
	Wastage coefficient(CD_s)	2,79	2,38	2,44
Modular approach	Number of student-modules	63,5	52,53	51,47
	The number of actual modules consumed by a graduate	34,23	32,89	30,86
	Efficiency coefficient (CE_m)(en %)	37,8	45,69	46,63
	Wastage coefficient CD_m	2,65	2,19	2,14
The ability to validate		3,79	3,68	3,51

We note in table 1 that

- The cost of forming a graduate of the 2007 cohort is 16.77 student-semesters for the semi-annual approach, and 63.5 student-modules (equivalent to 63.5/4 = 15.875 student-semesters) for the modular approach. The cost of forming a 2008 cohort graduate is 14.28 student-semesters and 52.53 student-modules (equivalent to 13.05 student-semesters), the cost of forming a 2009 cohort graduate is 14.66 student-semesters and 51.47 student-modules (equivalent to 12.86 student-semesters).
- Indeed, we have an underestimation of 16.77-15.87 = 0.9 student-semesters for the 2007 cohort, and 14.28-13.13 = 1.15 student-semesters for the 2008 cohort, and that extends to 14.66-12.87 = 1.79 student-semesters for the 2009 cohort, for each graduate. This underestimation appears enormous when multiplied by the overall number of students, and shows the amount of financial loss at the level of the entire cohort.
- The number of actual semesters that consumed each graduate on average is 9.33 semesters for the 2007 cohort, 9.13 semesters for the 2008 cohort, and 8.8 semesters for the 2009 cohort.
- One can compare the number of actual semesters with the theoretical number of semesters which is equal to 6. By multiplying this number (numbers of actual semesters) by 4 (number of modules in each semester), we get the optimal number of modules (theoretical) to form a graduate, so, for example, this is done 35.2 modules for the 2009 cohort, with an underestimation 4.34 modules with reality, which still justify the imprecision of the semi-annual approach.
- Between the cost and the loss in the half-yearly (time), and modular (unit) sense, the ability to validate gives a vision of effectiveness and efficiency in the half-yearly and modular sense at the same time. It is possible to consider the ability of validation to be the speed of a graduate to complete these studies and obtain his diploma. On the other hand, this is the answer for the question, how many on average, of modules per semester, a graduate is able to validate this number of modules per semester to obtain his degree with minimum cost?
- As long as this number is close to 4 (ideal case) the more efficient and efficient the system is at the same time. In our example (table 1), it took 3.79 modules per semester to form a 2007 cohort graduate, 3.68 modules per semester to form a 2008 cohort graduate, and 3.51 modules per semester to form a 2009 cohort graduate, so it is clear from these results that the 2007 cohort is optimal in terms of efficacy-efficiency than the other cohorts.

6. Conclusion

Based on the results obtained, we conclude that the calculations of the indicators mentioned in this article must be done in accordance to the modular approach instead of the semi-annual or annual approach. As a matter of fact, the same values obtained from these modular-based indicators appear closer to reality than those on a semi-annual basis.

As a perspective and to show the importance of our methods, it would be wise to recalculate the financial cost of each Moroccan student, and then calculate this cost for each graduate.

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