Modeling and Implementation of Human Resources Management Information System -Decentralized Human Resources Management Dashboard: Case of Moroccan Educational System

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Abstract— *The information system (IS) has become a complex amalgam of IT and is now one of the key weapons in the performance of the human resources HR function. From this perspective, our article will focus more specifically on one of the flagship tools of the pilot information system* [1] *namely the management dashboard. This instrument of performance piloting and resource optimization has the advantage of being able to respond effectively to the needs of managers in the education and training sector by constituting a real device for monitoring, managing, and optimizing HR. Yet the complexity of the educational system, due to the diversification of educational paths and the different bridges between courses on the one hand, and the massification of the educational system on the other hand 7.9 million students in 2022 (MENPS, 2022), geographically dispersed around the territory complicate the management of the resources necessary for the proper conduct of the teaching-learning process. This complexity is reflected in the management of resources by increasing the number of parameters to be processed, and the difficulty of the processing and calculations to be performed to predict the needed resources and to distribute them equitably. Among these essential resources are the provision of a teacher by class and subject taught and the provision of a space (classroom) adapted to the needs of the process. Our contribution in this context is materialized by the development of a matrix approach model* [2]*of the sub-process decentralized responsible for managing these resources: the Regional Academies of Education and Training (RAET) and the provincial directoriales (PD). Taking the parameter of temporal availability as a baseline and relying on the official texts relating to the pedagogical organization of the different teaching cycles, we were able to extract a set of characteristic parameters from each of the "primary, secondary, and high school grades ". From these characteristic parameters of the cycle, we have been able to develop an integral synthesis model in a matrix calculation software, such as Python. This model makes it possible to calculate (or even simulate) a configuration of the distribution of teachers and infrastructure for a given distribution of students.*

- *It can, from a given infrastructure, calculate a learner/teacher configuration.*
- *It also allows to evaluation of a real school configuration and to detection of resource-balancing faults.*
- *It also makes it possible, in the interests of optimization, to determine the optimal configuration of a school by minimizing the losses in hours/teacher and hours of work.*

Keywords— *Management dashboard, decentralized information system, educational system, teaching process, matrix approach.*

I. INTRODUCTION

Human resources management (HRM) in the Moroccan Ministry of National Education, Preschool and Sports (MNEPS) takes a strategic dimension since the success of any sector reform lies inevitably in the harmonization of HRM practices with the department's overall strategy. The information system (IS), being the cornerstone of this management, is at the heart of several studies that have been carried out by MNEPS and that have led to the launch of a program, the so-called HRIS for human resources information systems. Among the components of this program, are the SI MASIRH, E-movement, ESISE-RH … etc.

Today, those in charge of the sector have become aware that the real wealth of an organization relies primarily on its staff. The effective management of human resources has become one of the major challenges of the Moroccan educational system. Different stakeholders in the educational system, especially HR officials, agree that a decentralized HR management (especially of teachers) is essential and urgent to give a real impetus to the new reform of the educational system (Strategic Vision 2015-2030), then again to quantitatively adapt human resources to the needs of the various educational institutions and structures of the educational system in the short and medium term while taking into account the different parameters of the school system.

One of the most important components in the Department's strategy considers the current imbalance between the needs and the resources allocated, and the staff's sensitivity concerning the geographical allocation. This concern became a national priority within the framework of quality improvement affirmed in the National Charter for Education and Training (1999) and confirmed by the Emergency Plan (PU) 2009 and the Strategic Vision (2015-2030).

Part of the general guidelines of the National Charter of Education and Training, and the latest reform launched, mainly

aimed at the decentralizing of the governance system of the education and training sector, the Moroccan MNEPS reorganized all its administrative structures, from the central administration to schools, passing from the Regional Academies of Education and Training (RAET) and the provincial directoriales (PD), through the development of numerous legislative and regulatory texts.

The experience of Morocco in decentralizing the educational system management remains relatively in its initial stages, yet there is a real political will to work in this sense.

The main acts of human resources management, such as recruitment, promotion, retirement, etc., are always the responsibility of the central administration, apart from a few management acts that do not require the approval of the ministerial treasurer, which were transferred to the Regional Academies of Education and Training [3], [4], [5].

The decentralization of responsibilities concerning human resources management of central administrations in favor of operational services (regional or provincial) is one of the main reforms cited, certainly following modalities, degrees, and variable rhythms, yet affirming a determination to go in that direction. This trend is confirmed by the introduction of performance management, which has always been accompanied [6].

In this perspective, the conception's theme of a decentralized HR dashboard tends to occupy a predominantly representative position of the expectations of the educational system HR managers in terms of steering. As part of our study, and by highlighting the various parameters of the system to be considered in the development of this task, we have tried to deepen this reflection by choosing as a goal "The Optimization of HR through the use of a decentralized HR dashboard", accordingly we have adopted the following approach:

- First, we will introduce the HR command loop in the Moroccan school system (contextual framework).
- Second, deal with the dashboard's concepts and its relationship with the perspective of HR management in education and training (theoretical framework).
- Next, we will conduct an analysis of the education and training process and a modeling of a Human Resources Management Dashboard (HRMD) within the educational system, focusing on the functioning and the theoretical and operational foundations of this tool (the problematic and methodological approach).
- Finally, we will be interested in the simulation result as an integrated IT decision-making tool for the proper functioning of the IS-HR under Python (Results and discussions).

II. CONTEXTUAL AND THEORETICAL FRAMEWORK RESEARCH

A. The Moroccan Educational System

The morphology, the pedagogical structures, and the organization chart of the Moroccan educational system constitute its architecture and the network through which the learners develop defining the function of the supervisors (teachers).
- Pre-school education prepares for basic learning.

- Primary education, which is generalized from one year to another, becomes one step among others of school life.
- The secondary cycle evolved as an independent and autonomous cycle. It is increasingly a step in an ongoing process. Its transformations depend on the extent of compulsory schooling, the abolition of the selection between primary and secondary education, the organization of common trunks, the degree of diversification of the disciplines, the existence of accesses' means, and the age of educational and vocational guidance. Etc. that must be added the division into pathways or literary streams (classical-modern, scientific-technical, etc.), their durations (long or short), and the articulation between degrees and cycles.

In this school system, education and training are accomplished through teaching. The teacher by his job master's the techniques of the classroom, masters skills development methods, and possesses attitudinal correction techniques.

The core process within the educational system is the teaching-learning process. One of the bases of the "School of Success" project is to place the student at the center of the educational activity. This means giving more attention to the learning conditions in which he is expected to evolve.

Teachers organize learning activities, specify objectives, and develop sequential progressions. They constitute the most important category of personnel in the educational system. The teacher, ultimately, determines the effectiveness and efficiency of the system. The organizational management passes by a defined policy for the teaching function, the determination of needs of that category, and their identification.

B. Schooling Process

The school (primary and secondary) is the appropriate place where the optimal learning conditions are gathered: Teachers, locals, and equipment. Yet, we must first find a place in this school. The large number of learners to be instructed and the diversity of the contents to be passed on impose a rigorous organization of school access. Therefore, procedures and rules have been put in place to manage student access and mobility in the school system, which will include student education (including school).
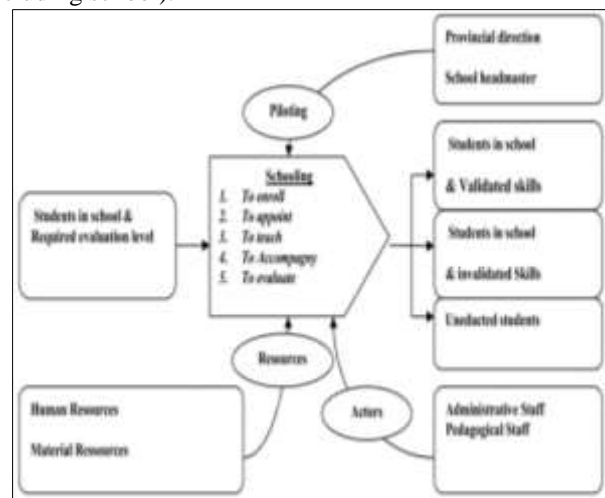

Fig. 1. Example of a figure caption.

As part of our contribution, we propose a schema of the "schooling" process (figure1).

This process is realized through a set of activities and requires a specific environment where it will draw its resources and pilotage elements. This environment is the school system that we outline with a functional approach shown in Figure 2 below:
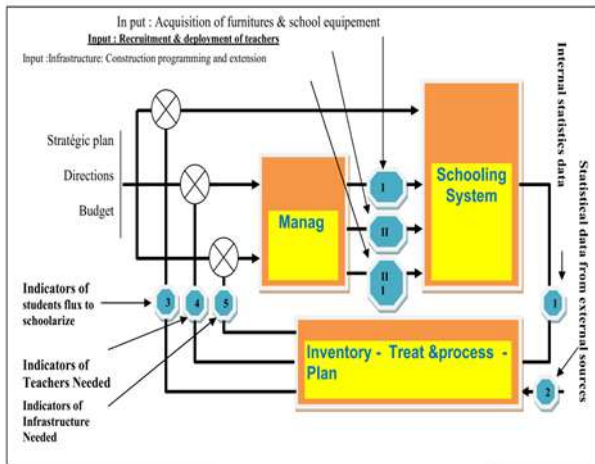

Fig. 2. Functional mapping of the Moroccan school system

C. Learning and Teaching Process

The teaching-learning process is the main production process of the school system; the acquisition of skills and attitudes are achieved through this process, and the quality and performance of the educational system depend on the effectiveness of this process [7], [8].

The rest of the local, provincial, regional, or central administrative structures represent only the supporting structures imposed by the complexity of the flows and resources management and imposed by the magnitude of the financial resources involved.

Successful education is about guaranteeing the conditions for the success of the teaching and learning processes.

The following tables (1 & 2) summarize the quality requirements imposed by each of the two processes.

TABLE I. Teaching process requirements

Student	Have the necessary prerequisites. Enjoying the optimal assimilation conditions
Content	Adapted to the teacher training. Adapted to the context of teaching. Sufficiently stated objectives.
Space	Adapted to the content taught. Follows the current standards. Optimal access conditions
Time	Adapted to the contents taught. Sufficient with objectives
Teaching means	Sufficient and available in quantity Sufficient in quality. Sufficiently documented. Adapted to the purpose of teaching

TABLE 2. Learning process requirements

Teacher	Have the required skills. Attentive and listen to the student. Smart in conflict management
Space	Adapted to the type of learning.

	Follows the current standards. Easy access (proximity).
Time	Adapted to assimilation. Sufficient with objectives
Didactic means	Adapted to the purpose of assimilation

D. The quantitative aspect of HRM in the educational system (ES)

Each public service tends to recognize itself as a decisively important service, and its staff is the first to strive to spread such a judgment, both psychologically flattering and financially interesting during the budgetary arbitrations that precede the setting of the level of remuneration [9], [10]. The National Education is not immune to this trend. At least two findings indeed support some recognition of such a sector. Quantitatively, education is one of the largest public employers in Morocco.

From this perspective, the demand for change in the public service framework is also vital. There is no doubt that the human resources axis and the educational system management are essential elements in the development strategy. Indeed, the optimization of the HRM and their redeployment in a balanced manner is effective, considering the social situation and in particular the endowment of the regional and local levels of competent staff.

To implement the organizational design (model) and allow a decentralized mode of HR Management, through the strengthening of the decentralization through the reiteration of the importance of the role and responsibilities of the provincial directions as external services of the RAETs managing the educational sector at the provincial level, it will be necessary to develop, beyond the management structures and systems, mechanisms and tools of work that will promote optimal management, partnership, teamwork, coordination and supervision of the proximity and accountability of the managers to the results achieved at each level of the ES structure (central, regional, and provincial, etc.)...

Developing the strategy and procedures for redeploying the existing staff considers the decentralization approach adopted by the MNEPS.

This last redeployment activity will allow for greater rationalization and better use of the available resources within the ES to reduce the shortages and surpluses currently encountered in certain cases, while promoting a better adequacy between the needs for qualified personnel, and the various positions to be filled, according to the competency profiles and required specialties.

At the operational level, it will be particularly important to clarify the processes of HRM and decision-making allowing a gradual and effective transfer of responsibility from the central level towards the RAETs of the resources in the post, following the decentralization policy recommended by the Charter [11], as well as the mechanisms of the redeployment of the staff, according to the specific needs of each school. To this end, a planned change strategy should be adopted by the MNEPS as well as appropriate action plans over an acceptable temporal horizon.

The ability to integrate the desired changes and the level of competence of the existing resources will necessarily have to

171

be considered to ensure the success of the anticipated change operation. In this way, the strategy adopted, and the action plans recommended must be put forward capacity building programs for the management services charged with the HR of education and training through work tools such as customized HR Tools of the various managers, mainly at the provincial and regional level to promote appropriate decision and proximity support.

This approach will therefore require harmonizing the HR education and training strategy with the organizational capacities of the decentralized administrations. All the means put in place by the HR function contribute to this result. HR actions undertaken as part of the strategic directions accompany the strategic deployment. A piloting system, such as an HR-GNUR, allows for checking its consistency, efficiency, correct deviations, and drifts [12], [13].

From this perspective, it is important to highlight the aspects that hinder the implementation of rigorous human resources management in the sector:

- The lack of staff control: indeed, in several RAETs, provincial directions, and schools, we notice that the workforce is not controlled, and the staff numbers remain approximate. This situation should be overcome because one of the conditions of good human resources management remains the control of the workforce for better planning and distribution of the staff.
- Management is based on rank and not on jobs and competencies: this difficulty remains significant since one of the axes of the development of human resources management remains personnel management based on a repository of jobs and competencies. The dockyard is big and there is a lot to do in this area.
- The humdrum and unpredictable human resources management: management remains limited because of the difficulties of transition to a forward-looking human resources management. This situation stems from the first and remains the logical corollary. We often talk about human resources management without thinking that this same management assumes prerequisites.

It is expected that technology and SI will bring about significant changes in how things are done and will impose new qualifications and therefore a promising prospect. The passage through technology is very interesting to note because technology will release the skills and place human resources management in another area, that of forecasting and strategic management of human resources.

E. Functional description of the IS -HR education and training

Due to our professional position within Moroccan educational institutions, we had the opportunity to access various technological platforms adopted by the Moroccan Educational System, as well as several different school and administrative databases, along with various audit reports on the Moroccan educational system's information systems. This enabled us to establish a database for our research project.

In line with this approach, and to comprehend the functioning of the education information system, particularly in the realm of HR, we conducted substantial fieldwork. This encompassed documentary studies, instrumented participant observation, and a few semi-structured interviews. We chose to follow the HR-IS actors within the sector as a relevant observational strategy.

Apparently, the HR domain can be characterized as a sector newly embraced by the education and training information systems. Functional versions of information systems related to this domain remain recent and continue to undergo significant improvement and refinement[14], [15].

It's noteworthy that applications pertaining to HR planning and management are quite prevalent within the landscape of education and training information systems. They demonstrate various functions that aid decision-making at all levels of the department. Notably, platforms like "MASIRH" and "ESISE RH" play a significant role. These electronic platforms enable the enumeration of personnel assigned to public educational institutions, updating or inputting associated personnel data (personal, administrative, qualifications, professional data, etc.). Additionally, this module allows for the creation of reports and tracking dashboards related to the personnel assigned to the institution.

As for the management of staff and personnel mobility within the ministry and the RAET, it is carried out based on well-defined parameters through a platform named "Movement du personnel" (Personnel Movement) on the website haraka.men.gov.ma.

"The Personnel Movement HARAKA" is an information sub-system dedicated to managing national and regional movements of both teaching and administrative staff. Teachers have the option to request interregional and interprovincial transfers (aiming to change their assigned institution) or intra-provincial transfers (with the goal of obtaining a new assignment within the same province or locality of their workplace).

These geographical mobility operations are organized at the national level with the dual purpose of, firstly, fulfilling teaching requirements that may not be met solely by the annual graduates from the Regional Centers for Education and Training, and secondly, considering the mobility preferences of staff members driven by personal, family, and other reasons.

In general, teacher transfers refer to the process through which teachers are moved from one educational institution to another, often with the purpose of meeting the needs of the educational system, balancing student enrollments, or filling vacant positions in various regions, provinces, and municipalities across the country. These transfers are usually carried out annually and are often overseen by the Ministry of National Education, Preschool, and Sports or the relevant administrative authority.

Interested teachers submit their preferences through an electronic participation form on the platform Haraka.men.gov.ma. This form can be accessed using an individualized account (@Taalim.ma).

A scoring system appears when entering these preferences, which corresponds to the administrative and family-related information provided.

Teachers need to confirm their participation in the movement by submitting the signed acknowledgment of

receipt, along with all necessary supporting documents, to their hierarchical superior (school director).

The calculation and verification of the scores displayed in the form are the responsibility of the school directors and the heads of HR services in each provincial directorate.

This verification of the scoring is done considering all the elements of the individual's personal, family, and professional situation of each participating teacher.

The results of national transfers will be publicly communicated on the ministry's website (www.men.gov.ma).

F. Theoretical Framework mobilized

As we have shown in the preceding lines, the educational system is a complex system due to the multitude of parameters to manage, the multitude of functions to perform (such as planning, pedagogy, and notably the human resources aspect, etc.), and the necessity to handle multiple and diversified human relationships (both internal and external, involving students, teachers, parents, various social or economic partners, etc.). All of this is aimed at fulfilling its mission, which is education and training.

The complexity of the HR information system in education and training reflects the growing complexity of the entire sector. The cause is twofold: On the one hand, information systems are gradually covering an increasingly significant portion of the scope of administrative entities responsible for the public education service (Ministry, Regional Academies for Education and Training, provincial departments, schools), and on the other hand, these organizations have a progressively complex mode of operation linked to globalization, the increasing demands of their constituents (students and parents), and their employees (teachers, administration), the shortening of timeframes, and the integration of services.

In the context of developing and designing an information system (IS), several theories and approaches are utilized to conceptualize, implement, and enhance information systems. These include the communication theory [16], [17]; theory of knowledge and organizational learning [18], [19]; innovation theory [20]; and decision support theory [17], [21], [22], [23]. These theories and approaches are not exhaustive, and practitioners in IS development can also combine several concepts to tailor their approach to the specific needs of each project and organizational context.

1. Decision Making in the Field of Information Systems (Mathematical Approach)

Decision-making is a significant field of study within Management Sciences, particularly in the domain of Information Systems Management. Indeed, the concepts of management, Information Systems (IS), and Information Technologies are closely interconnected through the concept of Decision Support Systems (DSS). This was highlighted by the work of H.A. Simon in his publication titled "The New Science of Management: Decision by Computer" [22].

For several years, researchers in the field of Information Systems (IS) have been focusing on the role of Information Technologies (IT) in enhancing the decision-making process within organizations. This is being done by adopting various research perspectives and theories.

The theory of Decision Support Systems (DSS) has evolved over time along with technological advancements and increasing access to data. It plays a crucial role in decision-making within complex and uncertain environments, thereby contributing to enhancing the effectiveness, accuracy, and transparency of decisions made by organizations and individuals.

Enhancing decision-making in a complex context involves generating novel solutions, i.e., creative solutions. In this context, as early as 1996 [24], the concept of a Creative Decision Support System (CDSS) was introduced, and research diverged into two streams. The first focuses on individual creative decision-making, while the second explores creativity within group decision-making.

However, it appears that research utilizing this dichotomy is facing theoretical limitations. There is a need for a theoretical foundation for the concept of creativity that can be applied to the design of a Decision Support System (DSS).

However, in the early 2000s, a new concept emerged in numerous research studies, known as "multi-agent DSS," as mentioned in [25] . The idea was to utilize operational agents as a means of implementing distributed decisions. The concept of distributed decision-making originates from the field of artificial intelligence and involves breaking down a task into different activities managed by agents that work in cooperation.

Decision analysis of complex systems is a discipline that aims to provide methods and tools for managing complex systems [26] or modeling chaotic environments [27].

Deterministic modeling is more focused on the internal aspects of the system [28]. It primarily concerns the arrangement of internal functions, whereas complex modeling requires interactions between functions, processes, and objectives. It demands an adaptive approach as the model is not singular and is not standardized. The model depends on the system, the problem, and the objectives. Modeling involves the expertise and experience of both the modeler and the user. This question has previously been raised by [29]) under the term "Model-Induced Intelligence."

Herbert A. Simon, in his work "Administrative Behavior," developed a decision-making model consisting of three stages: intelligence → design → choice [22]. Analyzing the decision-making process proposed by Herbert Simon helps to better understand the progression of various resolution phases. H. Simon distinguishes four phases: intelligence, modeling, choice, and evaluation.

In the field of HR management, and in most cases, the problem cannot be defined objectively but subjectively based on the manager's perception. Consequently, it is possible to construct different problem models from the same observed differences.

Indeed, an optimization system will help identify the best solutions from a set of possible alternatives, primarily using mathematical optimization techniques.

Optimization, on the other hand, is an approach that aims to find the best possible solution (maximum or minimum) from a set of options while considering specific constraints. Optimization can be seen as a form of bounded rationality [30],

where the decision-maker seeks to enhance the outcome based on available information and constraints.

In practice, decisions are often made under conditions of bounded rationality, where decision-makers use heuristics, approximations, and satisfactory decision-making strategies rather than attempting to examine all possible alternatives [23], [31], [32];These limitations can arise from the complexity of the problem, time constraints, uncertainty in available information, cognitive biases, and more.

Optimization is a powerful tool to aid in achieving effective solutions in the HR domain within the educational sector, despite the limits of absolute rationality. Optimization models allow for the consideration of various constraints and the discovery of solutions that come as close as possible to the ideal, even if they are not perfect. Therefore, while absolute rationality remains a theoretical ideal, optimization provides tangible means to enhance decision-making in real and complex environments.

Therefore, the mathematical perspective of decision-making through Optimization, which is the study of the best way to achieve a goal, assists managers in determining the optimal course of action in each situation. This approach emphasizes the computational aspect of rationality (problem-solving rather than problem-finding, as criticized by H. Simon). Our focus here is primarily on the modeling-simulation or decision-making phases (decisions in uncertain environments, classification, multi-criteria decision-making, etc.)[33]. We thus distinguish:

- Operational research aims to assist optimization through mathematical modeling of common problems (Fortz, 2013);
- Probability calculation aims to assist decision-making in situations involving calculable risks.
- Ranking methods aim to resolve choice dilemmas, whether they are based on a single criterion, multiple criteria, or collective criteria (Lecoutre, 2006);
- Automated classification forms the basis of new methods used in computer science: data mining, text analysis, artificial intelligence.

2. The -HRM- Dashboard

It should be noted that dashboards are at the heart of the HR management process. The quality and coherence of their indicators determine the success of the strategy deployed. In this section, we present the essential features of a management dashboard that meet management data needs. For example, several definitions of the GNBC can be seen in an enlarged literature review. Indeed, According to Alazard and Sépari, (2001), A dashboard is a set of indicators organized in a system that is monitored by the same team or the same person in charge to help to decide, coordinate, and control the actions of a service. The dashboard is a communication and decision-making tool that allows the management controller to draw the manager's attention to the key points of his management to improve it." For Boix and Féminier (2004), a dashboard is a tool intended for the manager to enable him through indicators presented in a synthetic way to control the operation of his system by analyzing the significant deviations to predict, and decide, to take action." Yet, according to Voyer and Voyer, (1999), HRM is "a way of selecting, arranging, and presenting

essential and relevant indicators in a summarized and targeted manner, generally in the form of a "look" accompanied by a ventilated or synoptic reporting, providing both a global view and the ability to drill down to levels of detail." According to Aubut-Lussier, (2013) , "Management dashboard (MD) is a lean steering system aggregating the essential data to the manager for a conversant decision-making, accompanied by a ventilated or synoptic report".

In short, MD can be defined as a way of selecting, arranging, and presenting essential and relevant indicators, in a summarized and targeted manner, accompanied by ventilated or synoptic reports, providing both a global vision and the ability to drill into the levels of detail.

In addition, the term "dashboard" refers to documents presenting dynamic information. This means that the information presented must put the results obtained into perspective with references, whether they are intended objectives or determinants, or past results achieved.

The dashboard allows a manager to be aware of the characteristics of his management and decision at close intervals. It indicates whether the results of the operations of a given period have been effective with the objectives that were selected during a given period [38]; Are they better, equivalent, or not as good as those obtained at the end of the previous period?

In short, it is an information medium used regularly to accompany an action or a decision.

It is a synthesized tool, a short-term information tool, designed for each responsibility department, focused on the action's variables to enable managers to take prompt corrective action.

The dashboard, therefore, provides an overview with details, but only if necessary. To account for their management, managers have accurate and detailed information from their operational systems. However, beyond the information needed for the operations and the analysis of situations, they must have a more comprehensive view» [39].

A HRM dashboard will, therefore, enable HR decentralized managers to have the significant levers on which they can proceed to guide, adapt, and correct the actions undertaken to achieve, under the best possible conditions, the desired optimization of resources . [13], [40].

Dashboards are tools for managers to control, manage activity and aid decision-making.

Through our theoretical contribution, we have highlighted the importance of employing a mathematical approach for the optimization of HR through the adoption of IS in the form of dashboard control panels, particularly within the decentralized Moroccan educational sector.

The objective in this context is not to eliminate the complexity observed, especially in the HR field, but to reduce it and, above all, to manage it.

Based on these observations, the implementation of any technology and IS (Information System) in the public administration responsible for managing this sector should consider at least three fundamental factors, namely:

- The imperative integration within a given sociotechnical environment (this is characteristic of any IS)

- Constraints related to the current legal framework.
- The profession and processes to which the information system applies (Optimization of Human Resources Management (HR)).

This last variable defines the intrinsic complexity, which is not reducible, of the information system in question [41], [42]. To this complexity is added the one due to the organization of the processes that the IS must support, as well as the inherent complexity related to the methods and technology used to implement the system and adhere to its non-functional constraints.

In conclusion, based on new technologies, the dashboard control panels constitute an effective management tool. However, the computerization of administration alone is not enough to establish good governance and efficient administration.

III. RESEARCH PROBLEM

The HRM in the school education department has a strategic dimension, through its contribution to the development and implementation of the overall strategy of the department, and also through the impact of the human resources function on all forms of teaching: school life, pedagogic action, teacher-student relationship.

As a result, the success of the sector reform depends inevitably on the harmonization and alignment of HRM practices with the department's overall strategy.

The Strategic Vision (2015-2030) [43] advocates for the decentralization of the educational system intending to streamline resources in the regional academies of education and training, as regional education, in particular, for human resource management.

The action of MNEPS is limited to the decentralization of a few management acts which do not influence the proficiency and development of human resources management. Additionally, almost all HRM processes remain centralized.

The RAET and its provincial directions do not have the power to act in terms of controlling and prospecting the needs for initial and continuous training, recruitment, career management, and sanctions.

This centralization of human resources management:

- Results in significant delays in staff stability despite efforts made by HRD in recent years.
- Does not allow RAET to control its management or establish a reliable HRM information system.

In sum, centralized human resources management does not guarantee the necessary control and flexibility for the proper functioning of forward-looking management of human resources or the optimization of their management.

The various structures responsible for managing human resources at the regional and provincial levels are suffering from deficiencies, given the large number of teachers to be managed.

Based on this observation and through this research work, we intend to answer the following questions:

- How does a management dashboard contribute to the improvement of a decentralized HRM in the Moroccan educational system?

- Why a dashboard of decentralized HR management in education & training?
- What is the approach to implementing an HR management dashboard to improve the performance of a decentralized HR Information System?
- How can the different data, parameters, and dynamic indicators of the school system be reconciled, exploited, and structured synthetically through an HR dashboard?
- In this regard, the questions identified in this research's theme aim to achieve the following objectives:
- Demonstrate the need for a decentralized HR management dashboard in the educational system.
- Demonstrate how to set up an HR management dashboard in MNEVTHESR and the various parameters to be considered.
- Develop a model for simulating an HR management dashboard of education and training that considers the different dynamic system parameters.
- To achieve these objectives, a research methodology will be adopted, it is intended to go back and forth between theory and practice while adopting a pragmatic approach, after scoping the theme and identifying the problem, two major interdependent steps will represent the substance of the methodology.

IV. METHODOLOGICAL FRAMEWORK: MODELING THROUGH THE MATRIX APPROACH

In data collection, the choice of relevant objectives, indicators, and metrics are information operations that allow studying the different functions, responsibilities, and hierarchical levels of the organization in terms of objectives and challenges. This is done to select from all possible information the useful and relevant indicators and parameters that best reflect the needs of each activity [44]

The primary role of a dashboard is to alert managers on their management to implement quick, effective, and corrective actions (it is often preferable to have real estimated elements rather than precise real data that are too late).

A. Identification of the action's variables:

The implementation of an HR management dashboard in education and training is based on a set of indicators grouped into different school management processes. Since the sources of information are multiple, the ideal is to be able to maintain the management approach on an information system that guarantees the speed of access and the quality of data, which facilitates the dissemination and sharing of information [45], [46], and provides sufficient flexibility to adapt to strategic developments. Progress in education and training information systems [47] offers a wide range of technical solutions adapted, and often oversized, to the needs of HR steering. Hundreds of data are added to and accessed every day in the various computer management databases.

It is a question of:

- Collect all HR data that will be useful to pilot HR performance, guide the action, and take decisions at the right time

- having selected the relevant information according to the nature of the decisions and determining the format of their presentation.
- Upstream of each decision, specify the nature and purpose of the analyses to be conducted to target the information.

To benefit from an effective tool, the HR department must, while respecting the rules for modeling the steering system of the entire school system, state its expectations and define the structure of its system. It is important to be able to articulate the system around the other decision-making centers, namely school planning, the construction service, etc. [48], as well as the operational centers (schools) and HR processes or events. Many HR actions have long-term results; the information collected must be able to be stored to monitor the indicators over long periods.

The reflection on the processes implemented in the school system occurs at this point in the process. This involves modeling these processes to extract the primordial action variables, which are factors that will influence the activity. The action's variables are levers of the action that will allow modification of the trajectories and reorient the activity in the desired direction. It is this modeling of school system processes (teaching and learning) that allows HR managers to be proactive and not just in the observation's position.

The HRM dashboard is thus biased, and selective and must be integrated into the strategy for decision-making [39].

The purpose of an HRM dashboard is to assist HR managers in decision-making within their jurisdictions (RAET or provincial directions). The table is selective: all the information about the school system, in particular the teaching-learning process, will be present in the dashboard, allowing to monitor in a quantified way the evolution of the HR staff and its employability in different educational institutions that belong to the territory concerned, to attain the strategic objectives previously defined. A serious reflection must be carried out to determine the action's variables.

Like any process, the teaching-learning process requires input on which it will add its value through activities and requires resources and a monitoring device (figure 3).

Fig. 3. The Teaching Process's Schema

The work presented in this article presents a matrix approach [2] to model the Resources (Input) branch of the Teaching/Learning process.

The actors in this process are the teacher and the student; the teacher is related to the 'teaching' activity and the student to the 'learning' activity. By looking at each activity separately, we will note that the 'teaching' activity requires as resources a space adapted to the object of teaching, appropriate teaching tools, and especially pupils whose pre-learning and profile allow them to assimilate and acquire the object of teaching. The "learning" activity requires, for its part, a space adapted to the learning requirements, didactic tools compatible with the learning situations implemented, and of course a teacher whose skills and profile enable him to accompany his students and to manage properly the learning situations. We conclude, although this seems paradoxical, that besides the student being the client of the process, he and the teacher are both actors and resources of the same process. The teaching and didactic tools section will not be included in the present modeling; rather it will be studied separately. The chosen resources for the rest of this work are the spaces, the pupils, and the teachers. The reason for this choice comes from the fact that these resources have a synchronous character and can all be identified by a parameter that we will designate as "temporal availability", «a possible class time " corresponding to the coincidence of the "time availability" of the learner, teacher, and space.
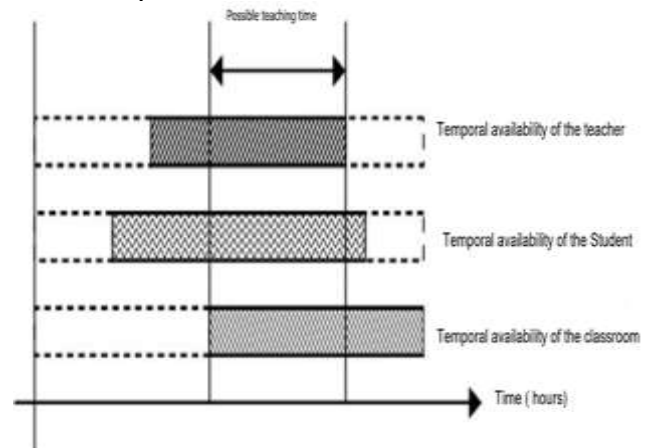

Fig. 4. Resources Temporal Availability Diagram

Taking the parameter of temporal availability as a reference base and relying on official texts relating to the pedagogical organization of the various teaching cycles, we were able to extract a set of characteristic parameters from each of the "primary, college, and qualifying" cycles.

- The characteristic matrix of the cycle: A_{ca} (cycle's characteristic parameters).
- The weekly time vector of a section: V_h (cycle's characteristic parameters).
- Student Distribution Vector: V_e (model's input variable)
- The theoretical class distribution vector: R_c (intermediate variable).

- The number of theoretical classes' spaces: N_{th} (model's output variable).
- The teacher distribution vector: E (model's output variable).

B. Modeling by approximation

In this modeling, we will assume the following three approximations:

- A classroom represents the space where the teaching/learning activity takes place. It can be an ordinary classroom, a specialized room, a laboratory, or a physical education ground. Thus, the number of Ne establishment's rooms, according to this first approximation, is a scalar that represents the number of all the included spaces type.
- The second approximation assumes that the reference reception capacity of a classroom is the scalar Cp_{ref} which represents the nominal value of the ordinary classrooms, generalized over all spaces-classes of any type.
- In the third approximation, it is assumed that the weekly availability D_h of an institution also represents the availability of all classes-spaces of that same institution.

C. The characteristic parameters

1. Matrix characteristics

The matrix characteristic of the cycle A_{ca} is determined from the official texts and guidelines accompanying the curriculum (Note 43/2007), the elements a_nm represent the time reserved for each subject (m) and designed for each of the sections (n). The section is defined as a homogeneous grouping of students' classes.

The primary cycle consists of 6 sections, one section per level,

Collegial education consists of 3 sections allocated to three levels,

The formation of the qualifying cycle is more complex since each level has several branches: 4 sections with a common core, 9 sections in the first year of the baccalaureate, and 14 sections in the second year of the baccalaureate, a total of 27 sections.

The school system consists of 36 sections and 56 subjects.

$$A_{ca} = \begin{pmatrix} a_{11} & a_{12} & a_{13} & . & . & . & a_{1m} \\ a_{21} & a_{22} & . & . & . & . & a_{2m} \\ a_{31} & . & a_{33} & . & . & . & a_{3m} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ a_{n1} & a_{n2} & a_{n3} & . & . & . & a_{nm} \end{pmatrix} \quad (1)$$

(m) is the number of subjects dispensed in the entire cycle and (s) is the number of sections in the cycle

- For the primary n=6 m=3
- For the collegial n=3 m=13
- For the qualifying n=27 m=39

In this context, we will consider generalizing the cycle's matrix characteristic to an overall school system matrix characteristic to develop a unique model of that system.

2. The weekly time vector.

From the cycle matrix characteristic, we deduce the weekly time vector of the H_c cycle due for each section of the cycle:

$$V_h = (v_1 \quad v_2 \quad v_3 \quad . \quad . \quad . \quad v_n)$$
$$\text{avec} \quad v_i = \sum_{k=1}^{m} a_{ik} \; ; \; (2)$$

v_i (Weekly schedule for section i of the all-subject cycle)

$$V_h = (\sum_{k=1}^{m} h_{1k} \quad \sum_{k=1}^{m} h_{2k} \quad ... \quad \sum_{k=1}^{m} h_{nk})(3)$$

3. Theoretical classes' distribution

$e_1, e_2, e_3 ... e_n$ the number of students in the respective sections $n_1, n_2, n_3 ... n_n$. if we suppose that the students' number per class is Cp_{ref}, at each student's class Cp_{ref} is reserved for the establishment of class space during the weekly schedule v_i. if the number of classes N_i per section n_i est $N_i = \frac{e_i}{Cp_{ref}}$, we deduct the theoretical class distribution vector from the cycle sections:

$$R_c = (R_1 \quad R_2 \quad R_3 \quad ... \quad R_n) \quad (4)$$

we pose $V_e = (e_1 \quad e_2 \quad e_3 \quad . \quad . \quad . \quad e_n)$ The students' Distribution vector on the cycle's sections.

$T = (t_1 \quad t_2 \quad t_3 \quad . \quad . \quad . \quad t_n)$ The rates vector of the students' Distribution of the cycle's sections with

$$T = \frac{V_e}{E_s} = (t_1 \quad t_2 \quad t_3 \quad . \quad . \quad . \quad t_n) \qquad t_i = e_i/E_s$$

$$N_{th} = \frac{1}{Cp_{ref}} V_e \qquad (5)$$

$$R_c = \frac{E_s}{C_{p_{ref}}} T \qquad (5')$$

4. Theoretical Number of spaces-classes

The overall schedule of school classes is

$$g = V_h . R_c^T \qquad (6)$$

$$g = \sum_{i=1}^{s} v_i . R_i = \sum_{i=1}^{s} \sum_{k=1}^{m} v_i . R_i$$

if D_h represent the school's weekly availability, the theoretical number of classrooms can be deduced N_{th}

$$N_{th} = \frac{g}{D_h} = \frac{1}{Cp_{ref}.D_h} V_e V_h^T \qquad (7)$$

$$N_{th} = \frac{g}{D_h} = \frac{E_s}{Cp_{ref}.D_h} T . V_h^T \qquad (7')$$

5. Teachers 'distribution.

if D_e represents the subject teacher's weekly availability m, we can calculate the teacher's distribution vector for the above configuration.

$$E = (E_1, E_2, E_3, ..., E_m)$$

$$E = \frac{1}{\delta_{\rho m}} R_C . A_{ca} \qquad (8)$$

$$E = \frac{1}{Cp_{ref}.D_e} . R_e . A_{ca}$$

V. IMPLEMENTATION OF THE SYSTEM

The model below assumes that all R_i classrooms have the same time availability D_h as that of the school, and that the reference number of students $C_{p_{ref}}$ is the same for all sections, all spaces classes, and all subjects. Thus, in these approximations, if we start from a given Student distribution vector V_e, the model can tell us about the N_{th} infrastructure and the theoretical distribution of the teachers E necessary for the correct accomplishment of the teaching-learning action. In the same way, the data on the institution's infrastructure, allow us to calculate its nominal reception capacity E_s for a given R_e students' distribution.
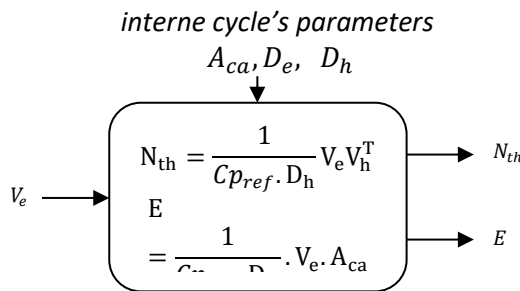
Fig .5. Model (student/teacher/space)

D. HR_Dashboard Interface

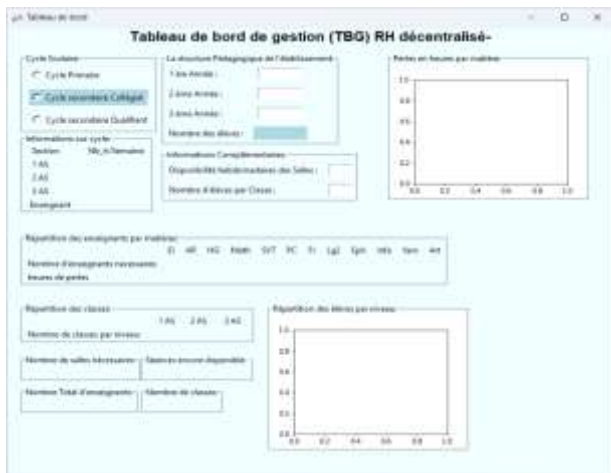The results will be displayed in the dashboard, implemented in Python, below: (figure 6)

Fig. 6. HR_Dashboard interface simulation of secondary school

1 Pedagogical organization

The tables below (3 & 4) are taken from the pedagogical organization note relating to a college education.

TABLE. 3. Subjects taught in collegial secondary cycle

ID	LIBELLE	Number of hours per week/level		
		1	2	3
1	Islamic Education	2	2	2
2	Arabic language	4	4	4
3	Geographical history	3	3	3
4	Mathematics	5	4	5
5	Life and Earth Sciences	2	2	2
6	Physics Chemistry	2	2	2
7	French language	4	4	4
8	Second foreign language	0	0	2
9	Sport	2	2	2
10	Family Education	2	2	0
11	ICT	1	1	1
12	Art/ Music Education	2	2	2

TABLE 4: Levels of the collegial secondary cycle

Sections		
ID	LIBELLE	Level
1	The first year of secondary school	1Y
2	The second year of secondary school	2Y
3	The third year of secondary school	3Y

2 Characteristic parameters

- Summary table

TABLE 5. Number of hours per level and per subject

Leve/Subject	1	2	3	4	5	6	7	8	9	10	11	12
1	2	4	3	5	2	2	4	0	2	2	1	2
2	2	4	3	4	2	2	4	0	2	2	1	2
3	2	4	3	5	2	2	4	2	2	0	1	2

- Matrix characteristic of the cycle.

$$A_{ca2} = \begin{pmatrix} 2 & 4 & 3 & 5 & 2 & 2 & 4 & 0 & 2 & 2 & 1 & 2 \\ 2 & 4 & 3 & 4 & 2 & 2 & 4 & 0 & 2 & 2 & 1 & 2 \\ 2 & 4 & 3 & 5 & 2 & 2 & 4 & 2 & 2 & 0 & 1 & 2 \end{pmatrix}$$

- Characteristic time vector.

$$V_{h2} = (v_1 \quad v_2 \quad v_3 \quad \dots \quad v_n)$$
$$avec \quad v_i = \textstyle\sum_{k=1}^{m} a_{ik} \; ;$$
$$H_{cc2} = (29 \quad 28 \quad 29)$$

3 Application Sample

Consider un establishment of $E_s = 706$ learners distributed as follows:

- 256 for the first year - 125 for the second year - 325 for the third year	$Cp_{ref} = 40$ learner/class $D_h = 44$h/week $D_e = 24$h/week ;

4 Dashboard Results

The execution of our dashboard using data from a collegial secondary educational establishment promises to provide a comprehensive set of results and information. This dynamic dashboard will offer a detailed overview of the requirements for this establishment, including the distribution of teachers by discipline, the breakdown of students by class, the number of classes, and much more. It will allow administrators to visualize the allocation of human and material resources in real-time, thereby facilitating more efficient management and optimal resource allocation. By highlighting these critical data points, our dashboard will streamline data-driven decision-making to enhance the institution's operations and ensure a quality learning experience for students. (figure7)
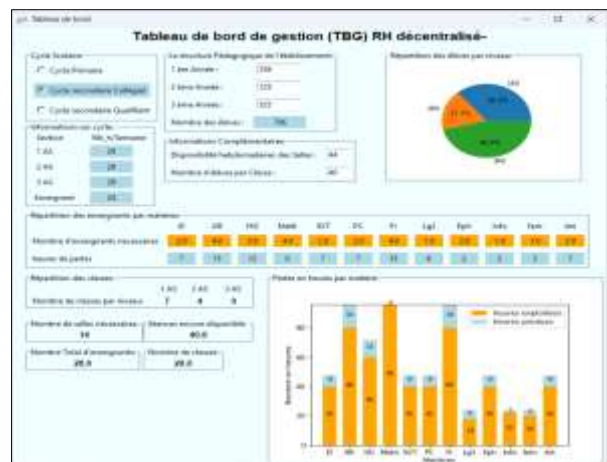

Fig. 7. Execution results

5 Discussion &Interpretation of results
- For the distribution given in the example, there must be 14 classrooms of 40 students.
- The teacher configuration detailed in Figure 8 must also be provided.

Fig. 8.   teachers' distribution

Losses in class-space hours and teacher hours (Figure 9) make it necessary to optimize allocations to make the best use of spatial and human resources by minimizing the excess
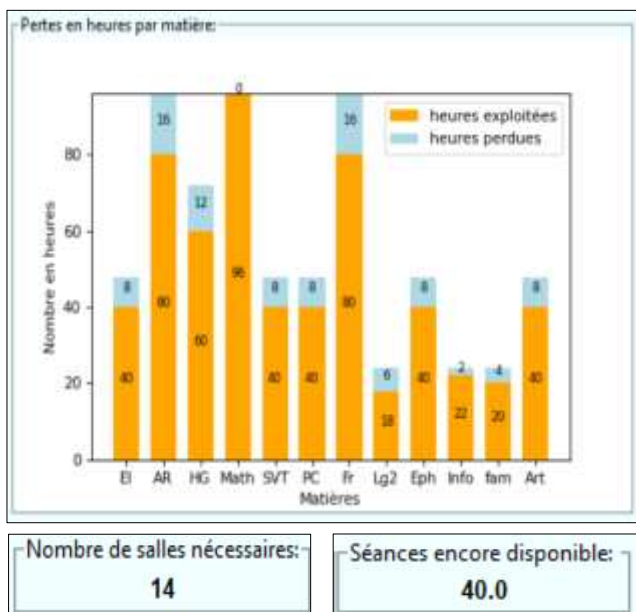

Fig. .9.   Losses in class-space hours and teacher hours

We will quickly notice that with the configuration of the teachers, we recorded a loss of 96 hours of supervision (figure 8), i.e. the equivalent of 4 teachers; and with the configuration of the classes, we are left with 40 sessions to exploit. This result leads us to reflect on the optimization of these configurations to minimize these losses.

As a conclusion, this research work represents a first step in a vast project that is just beginning to attract a growing number of researchers in IS management, and from which we have tried to contribute to the question of optimizing HR management through the adoption of an IS in the form of an electronic HR dashboard.

Our goal throughout this work was to explore, model, test, and then explain how the effort in developing an electronic HR dashboard contributes to improving the performance of an administrative service, namely, HR management within the Moroccan school educational system.

To achieve this, in the first step, we employed a flexible methodological design that encouraged both academic exploration (literature review) and practical investigation (Decision Support Systems theory, particularly Mathematical Theory applied to decision-making) of our initial theme (electronic HR dashboard for management). This approach aimed to address the major issues previously raised, highlighting the multitude of HR processes (a source of complexity).

The obtained results were synthesized within an analytical framework (matrix simulation model) that aspires to provide a response as coherent as possible to our research question.

The second phase of this work aimed at validating and testing the proposed matrix model, thereby strengthening the scientific framework of the accumulated results (verification of the optimization theory).

In this regard, of great importance to us, it should be noted that one of the objectives of this research is to provide practitioners and HR managers within the Moroccan educational system with insights to enhance the performance of implemented HR Information Systems (IS). To achieve this, we have put forward a matrix to assist in the selection of best practices related to workforce management, particularly for teachers. Additionally, we have clarified the concept of optimization and underscored the significance of an electronic dashboard for steering such organizations.

In other words, what matters here is precisely to design a coherent representation of the education and training IS that provides a significant "contextualization," thereby offering a comprehensive visualization of key indicators and parameters of HR performance through dynamic management and crossflow of decisions.

Such an approach is therefore a novel tool placed in the hands of researchers who will know how to use it. It is primarily an instrument of observation: it can be used as an explicit framework for observing phenomena. Moreover, it serves as an analytical guide: each principle provides directions for delving into the understanding of the functioning of the complex phenomena under study.

Thus, we anticipate that new models of administrative HR management in education and training, coupled with an electronic dashboard, could serve as strategic tools, particularly through their integration within the decentralized administrations of the system (RAET - PD), acting as "new capabilities" (Reix et al., 2011).

In other words, when dashboards were solely intended to monitor the conformity of outcomes with forecasts, the measurement system was relatively straightforward to design and implement [13]. The rise in uncertainty, complexity, and disruptions faced by the administration demands that management shift from a control process to a genuine steering system [50]

The effectiveness of dashboards relies on their proactivity, and their ability to accompany developments and decision adjustments. Time plays a fundamental role in the decision-making process [13].

Dashboards are no longer verification tools positioned during or after an action, but rather predictive tools preceding the decision. They accompany real-time decisions [13], [36], [37], [40].

The proposed HRM dashboard represents a significant asset in the education and training HR steering process. It is a technical solution that seems best suited to ensure the optimization of HR at the provincial and regional levels. The reliability of data, accessibility to information, an analysis tool, simulation capabilities, and querying functionalities all contribute to its effectiveness.

Upstream, the proposed electronic HR dashboard streamlines the allocation of teachers at the school level by managing surplus and immediate needs through its key functionalities:
- Optimal distribution of teachers'tiemtable volume.
- Management of excess teachers.
- Reporting and dashboard designed for the two decentralized HR decision-making levels (Regional and provincial).

VI. CONCLUSION

This article represents a component of a global model aimed at studying the performance of education and training information systems that we are currently empirically testing.

As we have seen in the simulation examples, the implementation of this model using Python allows us to take advantage of the computational power of this language, and it also allows us to easily consider all the parameters involved in the management of the teaching/learning process.

This can effectively replace the methods currently used by HR services and planning services based on conventional information systems revolving around databases.

Indeed, the use of the matrix-based HR dashboard can be applied at various levels of granularity, from managing a simple educational institution to that of a provincial directorate or an RAET. All that is needed is to have the basic input parameters, namely the student distribution vector, and the reference number of learners per class... which will be the subject of a future publication.

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