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Schools Benchmarking Platform
Integrating performance evaluation models based on Data
Envelopment Analysis

Diogo Borges

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Project Report
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Supervisor: Ana Camanho

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Approved in oral examination by the committee:

Chair: Henriqueta Nóvoa (Prof. Auxiliar)

External Examiner: Paulo Novais (Prof. Auxiliar)

Internal Examiner: Ana Maria Camanho (Prof. Auxiliar)

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Abstract

In the project “Schools Benchmarking Platform – Integrating performance evaluation models based on Data Envelopment Analysis” undertaken as the final project of the Master in Informatics and Computing Engineering from Faculdade de Engenharia da Universidade do Porto is proposed the development of functionalities of the existing initial version of the BESP (benchmarking for Portuguese Secondary School) platform, validating and testing the produced results and creation of a single global performance measurement based on Data Envelopment Analysis.

Evaluation of schools has become a very complex subject in the Portuguese society since the first publication of the schools rankings. Several school evaluation programs were created, but thus far none with the scientific accuracy and completeness of the BESP platform.

There was an existing version of the platform that was the starting point of this master project. This platform goal, after this Master project, is to provide a tool for the performance assessment of schools using two methodologies: Benchmarkings and Data Envelopment Analysis. For that purpose there is a set of performance indicators divided into 4 categories that characterize schools. With a close contact with schools (proportioned by several meetings with school board members) it was possible to redefine this set of indicators. Meetings with school boards also provided direct feedback that lead to considerable changes in the system.

The core of the architecture of the BESP platform was maintained but the majority of the components was improved and the missing functionalities implemented. Among other improvements, the benchmarking process was revised, the graphs displaying was changed, the ranking system redesigned and a report created method was implemented.

A particular feature was of special attention in implementation details: a global performance measurement (aggregating several indicators) based on Data Envelopment Analysis technique. Implementing this model, while integrating the solution in a benchmarking platform (BESP), constituted a breakthrough in this area as the solution was completely developed within the scope of this project.

In order for the entire platform to be considered ready to be launched it was tested thoroughly and is now robust and consistent. Since the platform manages a large number of data, the outputted results for both benchmarking and DEA scores were validate and cross-checked to the extent that it is now assured that the data is managed flawless.

Visting the schools provided feedback on the functionalities and it was also important to check the very good acceptance of BESP among school users.

It is now a platform complete and fully validated, tested, user-centered and ready to be launched and used by the universe of the Portuguese Secondary Schools where it can be a useful tool to aid both the self and external evaluation. This thesis constitutes, in addition, a documentation and description of the platform that can be of use in the future.

Resumo

O projecto “Plataforma de Benchmarking de Escolas – Integração de modelos de avaliação de desempenho baseados em Data Envelopment Analysis” foi realizado no âmbito da cadeira de projecto do curso do Mestrado Integrado em Engenharia Informática e Computação da Faculdade de Engenharia da Universidade do Porto e nele se propôs o desenvolvimento de funcionalidade e componentes da versão inicial da plataforma BESP (Benchmarking das Escolas Secundárias Portuguesas), o teste da plataforma, a validação de resultados calculados pelo sistema e a criação de uma funcionalidade para o cálculo automático de uma medida global de desempenho, que agregue vários indicadores, baseada na técnica de Data Envelopment Analysis.

A avaliação de escolas é um tema muito complexo na sociedade Portuguesa desde a primeira publicação dos rankings de escolas. Vários programas de avaliação de escolas foram postos em prática, mas nenhum com o rigor científico e a completude da plataforma BESP.

Desde o programa DEAVesII que já existe uma plataforma que foi o ponto de partida para este projecto de final de curso. O objectivo desta plataforma no final do projecto passa por providenciar uma ferramenta efectiva de avaliação de performance usando duas metodologias: Benchmarking e Data Envelopment Analysis. Para este propósito existe um conjunto de indicadores de performance que estão divididos em 4 categorias. Com um estreito contato com as escolas (proporcionado por um conjunto de reuniões com membros de conselhos executivos das escolas) foi possível redefinir este conjunto de indicadores para melhor caracterizar a realidade escolar. Estas reuniões também proporcionaram feedback directo de possíveis utilizadores, o que levou a mudanças consideráveis no sistema.

A essência da arquitectura do BESP não foi alterada, mas a maior parte dos seus componentes foram melhorados e as funcionalidades em falta foram implementadas. Entre outros destaca-se, a alteração do processo de benchmarking, o modo de apresentação dos gráficos, o re-desenho do sistema de ranking e a criação de um método para criar relatórios em formato PDF.

Uma funcionalidade que requereu especial atenção foi a implementação da medida global de desempenho baseada na técnica DEA. Implementar este modelo de DEA e integrá-lo numa plataforma de benchmarking constitui um *breakthrough* nesta área, uma vez que a solução foi completamente implementada de início neste projecto.

Para que a plataforma pudesse ser considerada num estado final e pronta para lançamento, foi testada meticulosamente para garantir agora que está robusta e consistente. Como o BESP trata uma grande quantidade de dados, os resultados do processo de benchmark e DEA foram completamente validados através de métodos de *cross-check*.

Visitar as escolas proporcionou, além do feedback, uma importante percepção do óptimo estado geral de aceitação do *website* entre possíveis utilizadores as escolas.

Esta plataforma está agora verdadeiramente completa, validada, testada, redesenhada com o utilizador final em mente e pronta para ser lançada a nível nacional e utilizada por todas as escolas Secundárias Portuguesas, onde pode ser uma ferramenta fundamental no auxílio a avaliação interna e externa. Esta tese constitui ainda uma forma de documentar e descrever o *website*, o que pode ser útil no futuro.

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Abbreviations and Acronyms

DEA	Data Envelopment Analysis
DMU	Decision Making Unit
PISA	Programme for International Student Assessment
OECD	Organization for Economic Co-operation and Development
SICI	Standing International Conference of Central and General Inspectorates of Europe
IGE	Inspecção-Geral da Educação
ESSE	Effective School Self-Evaluation
EU	European Union
ENES	Exames Nacionais Ensino Secundário
ENEB	Exames Nacionais Ensino Básico

1 Introduction

1.1 Context

This project “Schools Benchmarking Platform - Integrating performance evaluation models based on Data Envelopment Analysis” was done between February and July 2009, with the duration of 20 weeks under the final project of the Master in Informatics and Computing Engineering from Faculdade de Engenharia da Universidade do Porto (FEUP). The development of the project took place in Universidade Católica Portuguesa (UCP) – Pólo Porto and in Instituto de Engenharia Mecânica e Gestão Industrial (INEGI).

The context of this project is Education performance assessment in Portugal. Evaluating schools in Portugal is a polemic and important subject in both political and social view. Portugal as many other countries are constantly compared to each other in an attempt to assess the state of education. OECD (Organization for Economic Co-operation and Development), under the program PISA (Programme for International Student Assessment) tries to evaluate, in the main industrialized countries, every three years a set of student’s competences (mainly Mathematics, Reading Literacy, Science and Problem Solving). For each of the 3 editions of the questionnaire (2000, 2003, and 2006) the results of the Portuguese students rank below the OECD average and far from the best scoring countries. These alarming results show how important it is to look further into Portuguese Education to better understand why the Portuguese students are below the standards.

These results have been standing out in the Portuguese society and political efforts inherent to school evaluation are among the top priorities in the Ministry of Education. Therefore schools have been constantly faced with the need to look for new management and evaluation tools to support school boards in the (now) compulsory process of self evaluation.

This Master final project is integrated within the project DEAVesII (PTDC/GES/68213/2006) that began in December 2007. The DEAVesII followed project DEAVes (POCI/EGE/60561/2004) that started in June 2005 and was concluded in December 2007 both funded by Fundação para a Ciência e Tecnologia (FCT).

In DEAVes there was an effort to closely work with a small group of schools to identify a group of relevant variables to perform a fair comparison for the evaluation of schools. With a very small sample it was already possible to do an efficiency comparison of schools based on the Data Envelopment Analysis (DEA) technique (DEA is a method that allows a set of homogeneous decision making units to be compared on a set of outputs, while contextualizing the production of these with respect to the resources consumed). The DEAVes study pointed out benchmark schools whose good practices constitute an example to be followed. DEAVes II widened the original sample to focus on the universe of Portuguese secondary schools and under this project an initial version of a schools' benchmarking webpage was developed (BESP – Benchmarking Portuguese Secondary Schools).

Under DEAVes II, INEGI developed an early version of the BESP platform. This platform aims at benchmarking the schools in Portugal, most particularly the Portuguese Secondary Schools. The early version of the BESP platform represented a major accessibility improvement, as it enables providing schools administrators, teachers and parents (or other interested parties) up-to-date information, that is shown in such a way that can facilitate the decision making process. This platform benchmarking process is user defined (i.e. every user decides what indicator/s to see) allowing a level of detail that was not possible in other environments.

This platform was not ready to be launched, but the system had the following features when this master project started:

- To allow users to edit data and answer questionnaires to provide data online.
- To produce online benchmarking results for a set of key performance indicators.
- To provide easy to read results on self explaining indicators.
- To produce longitudinal analysis of the evolution of performance at the school level, allowing each school to assess how its performance has been changing over time.
- To enable the establishment of performance objectives for each performance indicator, by comparison with the best levels observed other schools.

The system was also able to produce a ranking table similar to the ones shown annually on Portuguese newspapers. This feature was however in early development stages and several improvements were required. The main objective of this project was therefore the improvement of an existing internet-based benchmarking system for a comparative study of the Portuguese High Schools (BESP).

1.2 Project tasks

The aim of this Master final project was the development of some components of BESP platform including implementing missing components and improving already functional ones.

It was as well a goal of this project to monitor and maintain the website, supporting schools in the first contact with the platform. This was done by conducting visits to northern Portugal based school boards members (one of the end-users of this platform). These meetings with school boards provided direct feedback from the schools on the available functionalities, and a number of suggestions and comments that lead to considerable improvements in the website.

This platform manages a very big set of indicators and results and one thing that the existing platform clearly lacked was testing and validation of the results. That was ensured by thoroughly testing all layers (see architecture chapter) of the project, and cross-checking the observed output results with the expected outputted results to an extent that now all the results are completely accurate.

The schools ranking system was redesigned and now provides easier parameters setting and better graphical displaying. There is also the possibility of different ranking ordering.

It was produced a functionality to provide an online user defined benchmarking report under the suggestion of a number of schools. This functionality creates a PDF file with the selected indicators results and has proven to be the most efficient way to distribute the results among other interested parties in the school.

The Benchmarking comparison method was improved to now allow comparison at the parish level (reducing the universe of school to be compared to the geographically closest ones).

The Annual Questionnaires section was improved to comprise the correct questions, correctly save temporary results and perform input error checking.

It was designed a new environment for the homepage allowing users to see the BESP structure at a glance with navigation links to the most important information pages.

The development of a performance evaluation system base on DEA required a thorough investigation on DEA techniques, implementations and available standalone software. It was decided to fully code the mathematical DEA model automatically solved and presented in the website using a linear programming solver from the open source project Computational Infrastructure for Operations Research (COIN-OR). This implementation of the DEA model is unique and its integration into a benchmarking platform (BESP in this case) was done for the first time in this project.

This implementation of this model (unprecedented as well in Portuguese secondary schools) enables the estimation of efficiency scores by taking into account the *resources* and *outcomes* of each school (DMU).

These two processes that this project focuses (Benchmarking and DEA) will provide great support for schools both in self evaluation and external evaluation. No other interactive website for

benchmarking in the Portuguese Education sector is online at the moment, so the implementation of this platform is a breakthrough.

The final result of this master final project is a fully tested webpage, available for schools and general public. The benchmarking results and DEA scores (relative efficiency scores) are now validated and accurate, and with improved graphical analysis of the results, aiding school with self and external evaluation.

1.3 Report Structure

This report is organized in 5 chapters with the following structure:

Chapter 2 explains in a more detailed way concepts introduced before. It goes further into explaining the concepts of benchmarking and School Evaluation. This section contains a review on the topics while distinguishing the Portuguese case from other countries.

Chapter 3 details on the BESP website. It focuses on the website structure, its modules and functionalities architecture and implementation decisions.

Chapter 4 explains the DEA model specification and implementation, the reasons why that particular model was chosen and a brief analysis of the obtained results.

Chapter 5 presents a short summary of the work developed, where the project results are discussed and it also points directions for future improvement of this work.

2 Review of Evaluation in Education

2.1 Introduction

This literature review explores 2 of the most dominant areas for this Project: Schools Evaluation and Benchmarking.

In the Schools Evaluation section it is discussed the Portuguese case and the several attempts to evaluate schools. There is also a chapter dedicated to school evaluation examples worldwide.

In the Benchmarking chapter it is described what is the process of benchmarking, its field of application, theoretical models, and implementations. Particular focus is given to the study of existing web benchmarking platforms since it is of the utmost interest for comparison purposes with the BESP platform.

In the chapter Data Envelopment Analysis a preview and explanation of the research made on this topic is provided. Also an important focus on performance evaluation in education using DEA is analyzed.

2.2 Schools Evaluation

2.2.1 Portuguese Case

In Portugal school evaluation scenario is a recent reality. Multiple studies, initiatives, programs or projects on education evaluation were put into action since the 90's but yet the number of these initiatives is still very low when one considers the state of education in Portugal nowadays. This may

be due to the fact that in Portugal “there is not an evaluation culture rooted enough and shared by the different responsible agents for education.” (Coelho et al, 2008)

“Self-evaluation has not been compulsory in Portugal. School Councils (established in 1998), in their capacity as school governing bodies, promote self-evaluation, as one of the school projects for improvement.” (The Standing International Conference of Inspectorates School, s.d. (b)) self-evaluation used to be developed on a voluntary basis, after more remote years when it was not even developed. School self-evaluation was an important step towards quality improvement and organization when external evaluation was not a compulsory or widely implemented culture.

With increased public awareness and political will several projects were put into action, and since 2002 the Bill on the Evaluation of Education was approved by the Parliament and school self-evaluation was stated as mandatory.

However it is important to discuss the few most successful projects in the Portuguese scenario. It is easier to better understand the actual evaluation model if one knows its predecessor programs. (Coelho et al, 2008; Azevedo, 2005; Portela et al, 2006).

2.2.1.1 Observatório da Qualidade da Escola

The first attempt to evaluate schools was produced in 1992 with the program “Observatório da Qualidade da Escola” under the responsibility of PEPT (Programa Educação Para Todos) of the Ministry of Education.

It was the first effort to evaluate the performance of the schools in Portugal. This project lasted 7 years (until 1999) and had the participation of around 1000 schools of the 2nd and 3rd cycle of instruction.

The goal of this project was to promote the quality of the schools, self-evaluation, autonomy, and the introduction of a cultural amendment in school management. It was based on international studies of OECD’s indicators for Educational Systems. It is a pioneer project that tries to gather systematically school data. The observatory was a starting point for school performance observation as well and data organization. The observatory also tried to fight school drop-out trends and failure at early stages (2nd and 3rd cycles)

This project, beyond the data gathering and production process, tries to produce an information system based on a set of 15 indicators (both qualitative and quantitative) that embraced socio-familiar context, educational resources and its management, school context and operation and Educational results.

The project however found several barriers mostly because the process of data gathering lacked effectiveness and the gathered data was not treated with in the most useful way. These two obstacles may have been due to the lack of experience or technical competence. (Coelho et al, 2008)

Although the participating schools had the obligation of providing the data they failed to see the project results, i.e. how the data generated could be helpful in the process of improving the school's performance. Year after year without a serious accompaniment of the schools lead to a "progressive disenchantment that a repetitive strategy, year after year, always brings" (Clímaco, 1995)

The project concluded in 1999 with some results, but perhaps the most important aspect of this project was the its pioneer nature that led to the social awareness for the importance of data structuring, data gathering, and providing the means for aiding a better school evaluation.

2.2.1.2 Projecto Qualidade XXI

In 1999 the "Instituto de Inovação Educacional" (IIE) started in Portugal "Projecto Qualidade XXI" under the European pilot Project "Scholar Education Quality Evaluation".

This project's subjects were schools with the 2nd 3rd and secondary cycles. In the first year the project was developed in 5 schools and the next year the universe was extended to 25 schools (Qualidade XXI, s.d.). Its focus was mostly self-evaluation – "To act efficiently it is important to know the reality of where one wants to act" (Palma, 1999)

In an attempt to improve the ways schools were trying to look at ways to improve its education system, this project was driven by the importance of providing different strategies to implement those improvements. The claim was that "self-evaluation tools and methodologies were a privileged mean to achieve that goal" (Coelho et al. 2008)

This monitoring and accompaniment of the schools was made by creating two different regulating entities: the monitoring group and the "critic friend". With the first entity was expected a heterogeneous group (school members or related) that ensure that the program was fulfilled assuring the good communication within all parts necessary for the self-evaluation process. The critic friend was supposed to be someone unrelated to the school that would assist the monitoring group.

The project finished in 2002 prompted by some obstacles. The financing for the "critic friend" was not possible anymore, the working tools for self-evaluation weren't provided to the schools and the results were too heterogeneous: while some schools quickly started to undergo measures to improve, others were concentrated in the techniques and methodologies. (Coelho et Al. 2008)

2.2.1.3 Programa de Avaliação Integrada das Escolas

This program started in 1999 by "Inspeção-Geral da Educação" (IGE) and around 30% of the scholar establishments were included in it. This project benefited from the experience gained in the previous two projects of common subject.

It was a project that marked a milestone in the evaluation models in Portuguese Education sector because it was the first one that used a methodology clearly focused in external-evaluation.

This project was unique at its time because it regarded the school as a complex whole, and it tried to provide an analysis covering different aspects of the school reality: resources, processes, results and actors.

The project focused on different management, pedagogical and administration areas covering several dimensions enabling a multidimensional analysis covering: organization and management, relational, participative and leadership climate, teaching and learning process, socio-familiar context and the pupil results performance.

The project ended in the school year of 2001/2002 with two major critics. The process did not concern by any means the act of self-evaluation, and the dimensions on which the evaluation would be done were exclusively decided by the evaluating entity.

2.2.1.4 Projecto Melhorar a Qualidade

In a cooperation between “Associação de Estabelecimentos de Ensino Particular e Cooperativo” (AEEP) and “Formação de Serviços em Gestão de Qualidade” (QUAL) started in the year 2000 this Project under the excellence model of European Foundation for Quality and Management (EFQM).

This was a project with around 50 schools connected with AEEP and focused mostly in providing to schools a self-evaluating process defined by the excellence model of EFQM.

Schools were evaluated on different indicators such as: leadership, personnel management, strategy and politics, partnerships and resources, processes and results. This methodology aims at identifying improvements opportunities in every sector of school activity. Being a self-evaluation project, the analysis of the results and the quality improvement plan were of the responsibility of the schools.

“Tough «Projecto Melhorar a Qualidade» covers the development of self-evaluating processes, promoting knowledge sharing and good practices, the lack of adhesion in the participating schools lead to the its ending in 2004” (Coelho et. al. 2008)

2.2.1.5 Programa AVES

In the year 2000 the “Fundação Manuel Leão” started “Programa AVES – Avaliação de Escolas Secundárias” and was supported by “Fundação Calouste Gulbenkian”.

This Project goal was “to connect, in each school context, the identification of performance quality promoting (and contesting) factors with the projects and actions that can be put to action in order to improve this social performance”. (Fundação Manuel Leão, s.d.)

In the first phase 13 schools were participating but then widening to 33 public and private schools. The used model was based on an identical one developed in Spain by “Instituto de Evaluación y Asesoramiento Educativo (IDEA)” of private nature, created by Fundación Santa Maria, with which the AVES program had a cooperation protocol (Fundação Manuel Leão, s.d.).

This model “values self-evaluation dynamics that are supported by external and independent information gathering (and treatment) mechanisms, as well as an integrated vision of the evaluation processes” (Azevedo, 2005).

The criteria of this process included indicators in the following areas: social-cultural context, school processes, class processes, teaching and learning strategies and students’ academic results. This project was completely confidential, provided added value results for each school and provided a longitudinal analysis of the results, because the data was gathered every year and allowed schools to produce comparisons of their performance between years. (Alves, 2002)

This is still an ongoing program and the adherence to it is voluntary.

2.2.1.6 Projecto Aferição da Efectividade da Auto-Avaliação das Escolas

This Project started in 2004 by IGE and was based in the project Effective School Self-Evaluation (ESSE) managed by the Standing International Conference of Central and General Inspectorates of Europe (SICI). (The Standing International Conference of Inspectorates, s.d. (a))

This project aimed at contributing to the development of a institutionalized perfected culture that is both strategic and focused; monitoring the development of external devices to support schools self-evaluation; developing a meta-evaluation methodology accordingly to the diversity of self-evaluation possible models; promoting in educational establishments a culture of quality, demand and responsibility through a critic self-questioning attitude in search of an improvement in processes quality and results. (Inspeção-Geral da Educação, 2005)

This self-evaluation process was of a compulsory nature for the around 250 schools participating. The process of admeasurement is defined in the project as: “the verification of the conformity or deviation resulting of the comparison between an observed real situation and a reference situation, build from the predicted in the norm, the scientific knowledge, professional experience and good practices”. (Inspeção-Geral da Educação, 2005)

For this purpose the activity is conducted by two inspectors with the maximal duration of 10 days. They collect information according to the guide, organize the data and produce a report.

A set of Quality Indicators were defined in order to provide a common fitting to the evidences gathering and assessment of value. This QI set was produced to be used in the meta-evaluation context, i.e. the evaluation of the school evaluation process. (Sousa et al, 2008)

This project pretended to examine quality levels in several domains like planning, management and school organization, student’s results and services providing.

In the year 0f 2006 this project concluded leading to the following program that somehow would overwrite this one.

2.2.1.7 Programa de Avaliação Externa das Escolas

This project started in 2006 under the Ministry Education. It was of the responsibility of a work group appointed for the schools evaluation. Started by the ministry in 2006 and later embrace by the IGE (before mentioned), this project was implemented in the entire teaching system in Portugal (around 1200 schools).

This program intended goal is to develop an external evaluation model that could be really close connected to the schools self-evaluation processes.

Among its objectives are (according to IGE, 2007 and IGE, 2008)

- Promoting in schools a systematic questioning about the quality of their practices' quality and results.
- Articulate the benefits of external evaluation with the culture and devices of self-evaluation in schools.
- Reinforce the schools capacity to develop their autonomy.
- Contributing to a better knowledge of schools and the public teaching system.

The project's first year (2006-2007) evaluated 100 management units compromising 609 teaching establishments.

The following year 273 management units were evaluated (1834 teaching establishments) which corresponds to close to 20% of the total establishments in Continental Portugal.

This process was conducted through visits to schools with average duration of 2/3 days and the evaluation domains were divided into: results, provisional of educational service, organization and school management, leadership and auto-regulation capacity and school improvement. The scales for evaluating purposes were classified into: Very good, good, sufficient and insufficient.

The results of this evaluation process were both disclosed in the School/Group Report and the National Report referring to every school/group evaluated in the current year.

This is still the current program used officially in the entire teaching system in Portugal with good possibilities to extend even further the percentage of schools/groups to be evaluated each year.

2.2.2 Worldwide

Perhaps the first and one of the most controversial studies in the field sociology of education was the "Coleman Report" ("Equality of Educational Opportunity"). Concluded in 1966 it was one of the largest studies in history with more than 150 thousand American students in the sample. It concluded that "student background and socioeconomic status are much more important in determining educational outcomes than are measured differences in school resources" (Coleman, 1966). The researchers "found that academic achievement was less related to the quality of a student's school and more related to the social composition of the school, the student's sense of control of his environment

and future, the verbal skills of teachers, and the student's family background” (Kiviat, 2000). This report was a massive 700 page report surrounded with political controversy mostly because of very volatile social causes as segregation and the racial relations and equality.

In Spain the National Institute for Quality and Evaluation was created in 1990 and its functions and structure defined in 1993. This institute is the organization responsible of the assessment of educational system of the Spanish Ministry of Education and Science. “All the functions of the Institute of Evaluation are realized in coordination with educational Administration: elaborating multiannual projects of general assessment of educational system; coordinating the participation of Spanish State in international evaluations; elaborating the National System of Education Indicators that will contribute to the knowledge of educational system and to orientate the decision-making of educational institutions and of all sectors implied in education; collaborating in the realization of general diagnostic assessments, which permit to obtain representative data, as well from students and centers of the Autonomous Communities as the whole State, in the framework of general assessment of educational system.” (Ministerio de Educación, s.d.)

The panorama in of education evaluation in Spain is comparable to the Portuguese case. There is a steady evaluation and decision-making program implemented since the year 2000 and therefore the experience gathered and the improvements made since the beginning of the project made this a very efficient project.

In the European Continent, though the evaluation model differs from country to country the majority follows a trend to have school self-evaluation and external evaluation models.

A deep insight on each country would go outside the scope of this project but it is worth mentioning Eurydice. Eurydice is an institutional network for gathering, monitoring, processing and circulating reliable and readily comparable information on education systems and policies throughout Europe. First launched by the European Community in 1980, the Eurydice network consists of a European Unit set up by the European Commission in Brussels and National Units established by education ministries in all countries taking part in the EU Action Programme in the field of Lifelong Learning. (Eurydice, 2009)

In the following figures it is possible to describe the evaluation in Education panorama in early 2000's in the European Union countries. (Eurydice, 2004)

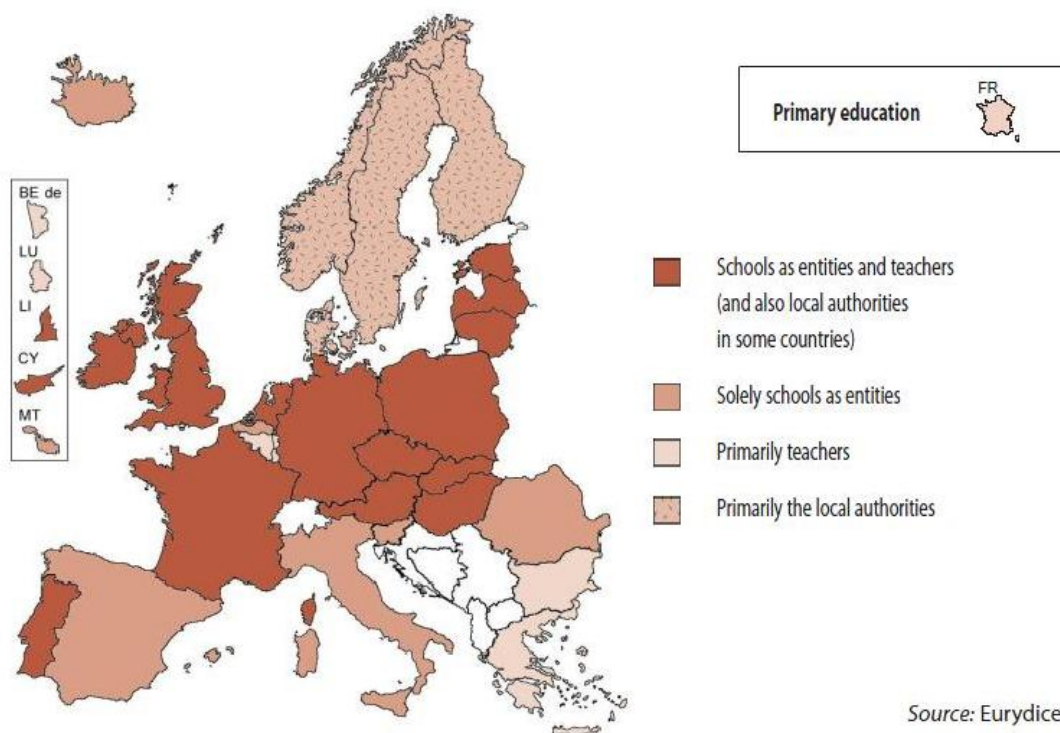


Figure 1 – Aspects Central to the System of Evaluation, Compulsory Education, 2000-01

In 2004 Eurydice described four major categories of evaluation system, depending on what is evaluated (solely in the schools, primarily in teachers, schools and teachers or primarily the local authorities).

It is possible to see in Figure 1 that the majority of countries seem to follow focus on schools as entities and also in some cases local authorities. Exceptions are the Nordic countries minus Iceland.

In all these categories, schools as entities are evaluated by an inspectorate in the case of external evaluation, and also by the school community during (compulsory or strongly recommended - by the government or other regulating entity) internal evaluation. Evaluation conducted by the inspectorate is of great importance in almost all countries. In many of them, it is supplemented by inspections carried out by specific government departments.

“Most of these countries have drawn up lists of national criteria for the purposes of external evaluation. Furthermore, in some countries (especially those in the second category – see Figure 1 key) pupil attainment may be used as a basis for evaluating the education system.

The difference between the two categories hinges on whether or not teachers are evaluated. Alongside the evaluation of schools as entities, teachers in the first group of countries are evaluated on an individual basis by their school heads in nearly all cases.” (Eurydice, 2004)

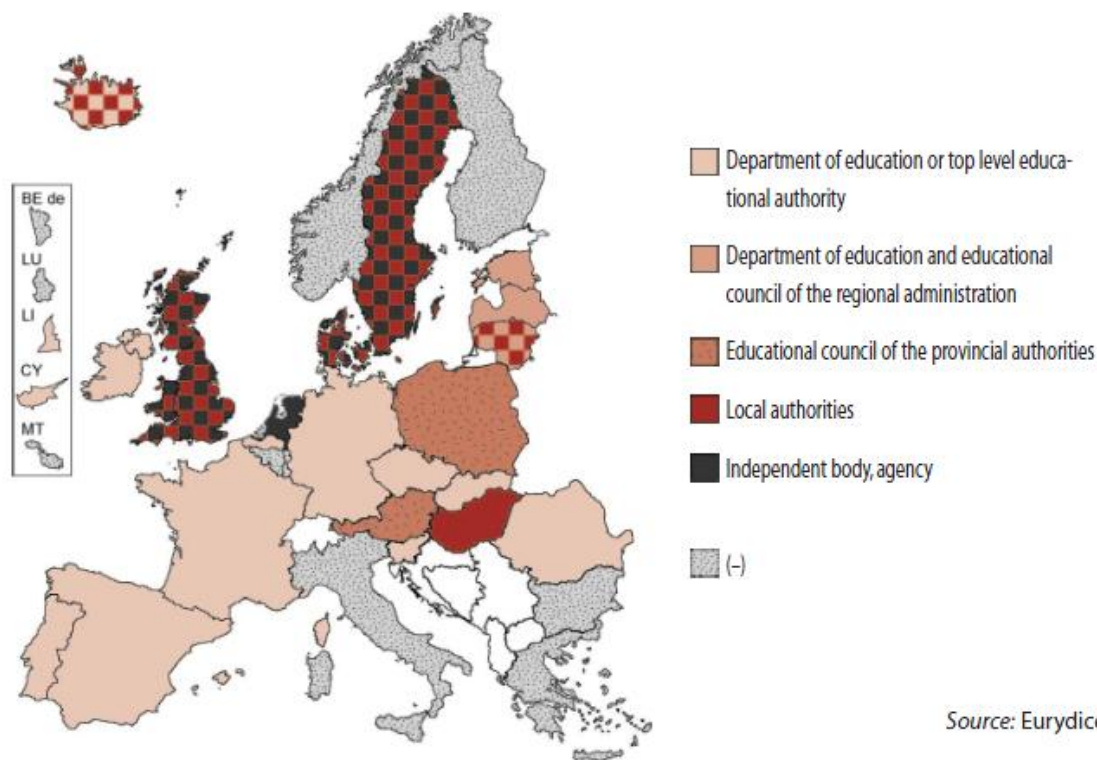


Figure 2 – Bodies responsible for the external evaluation of schools as entities, 2000-01

Figure 2 shows the variety of bodies responsible for external evaluation. It is worth noticing that while there is heterogeneity in the bodies responsible sometimes with the conjugation of more than one body responsible for the external evaluation. Some countries do not provision for external evaluation like Italy, Greece, Bulgaria, Belgium (French and German community), Malta, Luxembourg, Norway and Finland.

2.3 Benchmarking

2.3.1 Definition

“Benchmarking is the continuous process of measuring products, services and practices against the toughest competitors or those companies recognized as industry leaders.” (David T. Kearns, chief executive officer, Xerox Corporation)

According to Robert Camp (1989), benchmarking “is the search for those best practices that will lead to the superior performance of a company. Establishing operating targets based on the best possible industry practices is a critical component in the success of every business.”

Most precisely benchmarking is the process of comparing the cost, cycle time, productivity, or quality of a specific process or method to another that is widely considered to be an industry standard

or best practice. “Essentially, benchmarking provides a snapshot of the performance of your business and helps you understand where you are in relation to a particular standard.” (Dumford, 2007)

A simple Japanese word explains very well the essence of benchmarking: *dantotsu* - striving to be the “best of the best”.

Benchmarking provides the opportunity for organizations to be compared to each other and, in the process, the opportunity for learning from the best organizations, looking at the best practices in each or all areas that are being benchmarked.

To be successful benchmarking must be continuous and systematic. It cannot be performed once and disregarded thereafter on the belief the task is done. (Camp, 1989)

All types of industries or provision of services have a similarity: its practices constantly change. Industries are very dynamic, always changing, adapting to new circumstances, environments and economic stands. The result is the fact (and with recent years it is even more evident) that a company cannot stand placid on an industry because of the several dangers that may lead to its downfall.

It is well known that in an industry there is no comfortable position where a company can relax and stop being active. The leaders or the competitors continuously get stronger so it is important to keep targeting the real (and actual) industry best practices. “Only those firms that pursue benchmarking with discipline will successfully achieve superior performance. In an environment of constant change complacency is fatal” (Camp, 1989).

“Benchmarking is not just a study of competition but a process of determining the effectiveness of industry leaders by measuring their results”. (Camp, 1989)

Benchmarking can be applied to all aspects of a business. Both products and services can be benchmarked. The manufacturing process of given products and services can be benchmarked. Every aspect that goes from the production to delivery to the client (basically every step of the production process) can be benchmarked. Though the early stage benchmarking exercises were taken on industries its practices quickly extended the universe of provision of services where the basic principles still stand.

Benchmarking implies that act of measuring. What to measure depends on what is considered the key aspects on the industry or service. Usually there are two ways to produce the measurements: internal and external practices. These practices can be put together to produce an analysis that would result on the “industry best practices that may be implemented to achieve improvement” (Camp, 1989).

Identifying the best practices in an industry does not necessarily aids to determine what management and planning decisions to make in the company. Usually a company that is not in the leading position cannot just improve on every identified best practice.

In order for the benchmarking process to be a better decision making supporter it is important to quantify the gaps between practices. Knowing where is the opportunity to improve it helps to know

how much in that practice can the company improve. “It quantifies the size of the opportunity”. (Camp, 1989)

It is important to pursue both qualitative and quantitative metrics on the benchmarking process. The conjugation of both will ensure that the study helps determining what practices are being used as a competitive advantage and what results that practices should output.

The possibilities are numerous as and the decision on what to benchmarking is strictly connected to the success of the benchmarking output analysis. Provided that the benchmarking process is executed correctly and responsibly choosing “what to benchmark” may be one of the most important decisions to make.

Camp (1989) states that “Benchmarking goes beyond the traditional competitive analysis to not only reveal what the industry best practices are, but to also obtain a clear understanding of how best practices are used.”

In general the most common thing to benchmark is *processes*. A process, here viewed as a set of transformations of input elements into products with specific properties, may be representative of almost any business activity. But when one goes into the specifics of a business processes these may be very particular, and for that case an effective benchmark of the process implies a correct identification of similar processes in other companies, and if that task is unsuccessful perhaps consider discarding the possibility to benchmark the particular process.

The investigation part of the benchmarking process is very important as well. Only identifying direct product/service competitors could be a common mistake as they may not be best practices at all in a particular segment of the industry. Therefore careful investigation is grand to determine companies to be benchmarking partners.

Camp concludes that “Benchmarking is an ongoing investigation and learning experience that ensures that best industry practices are uncovered, analyzed, adopted and implemented. It focuses on what best practices are available. It ensures an understanding of how they are performed. And finally it determines the worth of the practices or how well they are performed.”

2.3.2 The Benchmarking Process

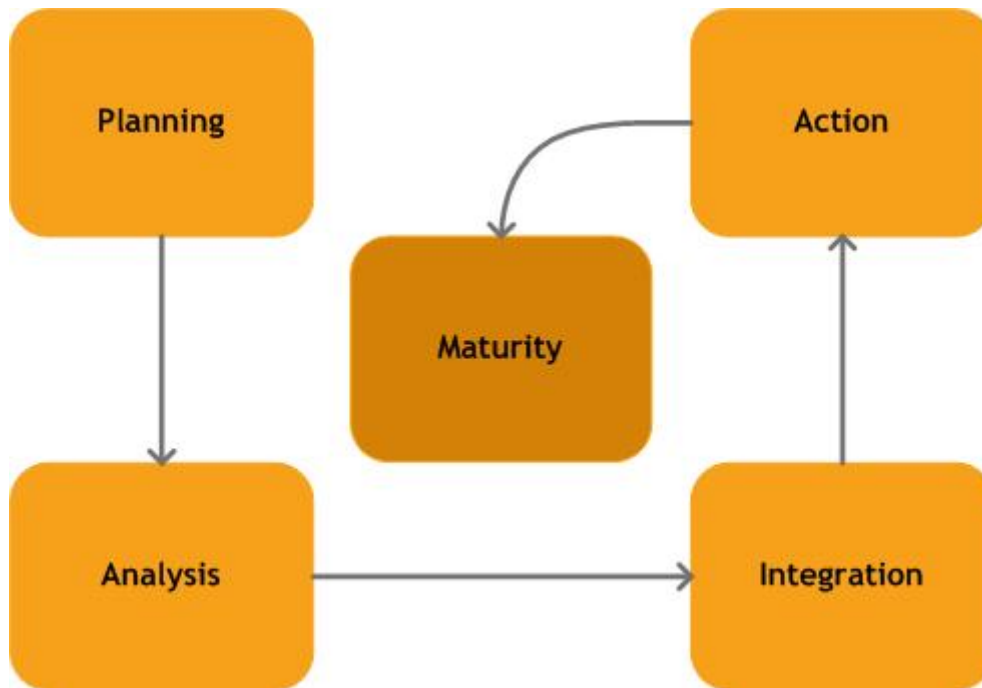


Figure 3 - Key benchmarking phases

Benchmarking has five key process phases (as can be seen in Figure 3).

The process starts with a planning phase and proceeds through analysis, integration, action and finally maturity.

Planning - This phase is designed to develop the plan for conducting the benchmarking investigation. The essential steps are the most common for any plan development: what, who and how.

- Identify what is to be benchmarked.
- Identify comparative companies(benchmark partners)
- Determine the data collection method and collect data

This phase will form the basis for the entire benchmarking investigation and consequently, every effort should be made to complete this phase as thoroughly as possible.

Analysis - In this phase, the data collected in the benchmarking study is analyzed so as to provide a basis for comparison. In the core aspects of this phase are:

- Determine performance gap
- Project future performance levels

Answering the questions:

- What is the performance of the benchmark partners?
- What is the company's performance compared to them?
- Why are they better?
- What can the company learn from them?
- How can the company apply the lessons?

Answering these questions will provide the dimension of the performance gap which itself “provides an objective basis on which to act – to close the gap or to capitalize on a positive one”. (Camp, 1989)

Analyzing the data and answering the above mentioned questions is important not only in the exercise for the present but for the future as well. As it was stated earlier the benchmarking process must be a continuous act, so that “performance is constantly recalibrated to ensure superiority.” (Camp, 1989)

Integration - The objective of this phase is to develop goals and integrate them into the benchmarked process so that significant performance improvements are made. It is the process of using benchmark findings to set operational targets for change. In the core aspects of this phase are:

- Communicate benchmark findings and gain acceptance
- Establish functional goals

In this phase the key questions are:

- Has management accepted the findings?
- Do the company goals need to be modified based on the findings?
- Have the goals been clearly communicated to all involved parties?

Action – After the benchmarking findings have been communicated, accepted and goals established it is obvious that these findings and operational principles must be converted to actions.

- Develop action plans
- Implement specific actions and monitor progress
- Recalibrate benchmarks

This is the phase where measures are actually executed. When these measures are put into action it is important to incorporate as well a system for periodic measures to see assess the measures puts into action. Only with periodic measurement can a company face to the fact that a benchmarking finding may not actually valid a couple of months after (Industries are commonly very dynamic - see definition chapter).

Maturity – Maturity may or may not be reached depending on the effectiveness of the previous phases. This is a state when best industry practices are fully incorporated in all business processes providing superiority.

Main characteristics:

- Leadership position attained
- Practices fully integrated into processes

Superiority needs continuous testing. Other companies will benchmark the internal processes of the company and that will lead to a snowball of evolution in the industry, thus it is important to always *dantotsu* (striving to be the best of the best).

2.3.3 Benchmarking and Education

In what concerns the Education benchmarking, sector two different types of benchmarking can be applied: Internal and External Benchmarking. This is due to the nature of a typical Education organization. Schools are very complex and dynamic and because they embrace a large number of working staff certain autonomy between departments is created.

Internal Benchmarking can be useful for comparison purposes between disciplines or disciplinary group. This type of benchmarking may be very useful to expose efficiency differences among disciplines.

Among the steps (mentioned above) for a benchmarking process it is easy to understand that when internal benchmarking is concerned, the planning phase would be less time/effort consuming because generally there is a better understanding from the school boards of their own school. The investigation would be easier in this case. The data collection among the school is as well a lot easier since it is easily obtained. Another advantage is the easy integration step. Communication and acceptance gathering on school improvement is usually very well received by the responsible organs. As in the regular benchmarking exercise putting the findings into Action may be an extremely hard task to do. Schools may be conditioned by local authorities, government impediment, insufficient funding or human resources and other factors.

This process may be a good instrument alongside with other tools of internal evaluation (self-evaluation) for a reflection exercise on the school as a whole, or considering its various different sectors.

External benchmarking is the act of benchmarking the education system (here seen as “industry”) with its various teaching establishments. The easiness discussed in some of the benchmarking phase for the internal benchmarking does not apply to the external version. Gathering data from other schools might prove to be too hard as there are too many schools and too many information to gather. It is easy to understand why external benchmarking would have to be a great effort if it was conducted by schools.

The solution for this problem is the conduction of external benchmarking by an external agent to school (Ministry of Education, private organizations...). This last benchmarking exercise can lead to outstanding results with immediate findings. But there are problems with the benchmarking phases because they are not all conducted by the same entity. While the Planning is done by the external agent, it is recommended that the analysis is conducted by the schools. Obviously the integration and action (tough conditioned by other agents) can only be of the responsibility of the schools.

2.3.4 Web Benchmarking Platforms

This master project focuses on implementing and improving an existing benchmarking platform for Secondary schools, BESP.

Of the most renowned web platform on the field of benchmarking and DEA is the iDEAs tool by the Georgia Institute of Technology in the United States. The initial provided benchmarking exercise was destined to warehouses and other industrial systems. This platform allows the combination of both benchmarking and Data Envelopment Analysis and the results of these techniques were provided online. Through a set of input and output metrics simultaneously in the analysis this system does not have the need for arbitrary or subjective weight factors (iDEAs, s.d.). To companies wishing to participate in this project had to register themselves and then after uploading the information required a set of similar companies is presented for comparison analysis. This project started in 1999 and is still functioning.

In Portugal there is an online benchmarking tool destined to companies of the civil construction business: “icBench” (Mercatura, s.d.). This project was created in 2005 by INEGI and allows the auto diagnostic of the productive activities when considering annual performance and individual operations. This restrict platform provides the comparison among companies accordingly to the performance and productivity indicators available. The results of this benchmarking exercise are then displayed to the user to be of help in the decision making process.

There are several examples of online benchmarking tools in the Education area.

The Tennessee Value-Added Assessment System (TVAAS) in the United States is unlike any other state-wide accountability program. Instead of ranking schools by how their students score on a standardized test, it provides information to teachers, parents and the public on how schools are doing in helping each child make academic gains each year. It provides information to school administrators to identify weaknesses in even the strongest schools. And it provides information to central administrators, school boards and policy leaders to ask harder, more penetrating questions (TVAAS, s.d.).

Using the results of several different tests in grades three to eight it is performed a value-added analysis. Value-Added Analysis takes the gains each student makes from year to year and compares it

to the gains made by a normative sample for that same subject between those same grades. (TVAAS, s.d.).

In the United States as well, there is in city of Dallas a value-added accountability system for the city's public schools. This is an accountability system that is "multifaceted, tying together district and campus improvement planning, principal and teacher evaluation, and school and teacher effectiveness" (Webster, 1997). This system sets and measures progress on absolute continuous achievement goals and provides the registered user with a "Diagnostic Summary Report", a "Performance Diagnostic Summary Report" and a "Student Projection Report".

There is a website for benchmarking schools named "schoolbenchmarking.com" that provides detailed benchmarking analysis for thousands of elementary, middle and high schools to the New York State and the Arizona State Departments of Education and the Magellan Foundation. This site users can find benchmark schools that act as models to help school improvement teams to: set and justify improvement targets, seek the programs, strategies and practices necessary to achieve those targets and allocate available resources to implement improvement strategies and achieve their targets. (Prism Decision System, LLC & Idea Science, Inc., s.d.).

In Portugal the pioneer attempt to produce an online benchmarking tool for schools was developed by IGE (IGE, 2006). In 2006 IGE provided information about the students' results and a tool that would allow them to produced comparison with other schools results, at county level or with the same level of Social Development Index.

This programme expected that the school knowledge of its own could be useful not only for the school but for the universe of participating schools as well: the idea behind benchmarking.

This platform lacked in questionnaire efficiency, because it could not be answered online, and therefore to obtain the results there was a waiting period. The content of said questionnaires is very complex and often schools did not have the means to gather all the information required (tough when the schools registered in the project a compulsory measure was the creation of a self-evaluation team within the school).

This platform, tough still available online is completely out of date.

The study of the several online benchmarking platforms was a key process in the development of the BESP platform.

2.4 Conclusions

With this Review of Evaluation in Education was possible to explore all the different perspectives of the complex problem of evaluating schools.

It's very clear that there is a concern with schools quality demonstrated by the number of programmes and initiatives that were put to action in these last couples of years. On the other side, this number of initiatives only occurred because students' results, when compared with their European peers, are constantly ranking near the bottom. The bad results of the students motivated more initiatives to assess school performance, but the cycle is expected to stop with this BESP platform.

Benchmarking is a performance evaluation technique working under a set of key performance indicators that aims at allowing schools the strong and weak points of their teaching establishment. This practice will support school board members in the process of decision making and the strategies development and implementation.

There is a wide variety of online benchmarking tools in such different environments as: warehouses, construction, financing or Education.

3 BESP – Benchmarking for Portuguese High Schools

3.1 Introduction

As mentioned earlier in chapter 1, the goal of this master project is to produce components of a website that allowed a school benchmarking method and performance assessment using the Data Envelopment Analysis methodology.

3.2 Architecture

3.2.1 Modules

This platform is divided in main modules. The first module regards the interaction with the client user when it is expected the user will provide data that needs to be stored in the BESP database. The second module regards the treatment of the gathered data, meaning that this module will calculate results or organize the information to be presented in a different way than it is organized in the database. The third and last module is concerned with the displaying the information managed by the Data Management Module to the end-user.

3.2.1.1 Data Inserting Module

The user interaction with the platform has two directions. This module regards every aspect of the platform that is oriented to the user inputting information in the platform (using the web browser).

Most particularly this module deals with the schools annual questionnaires where the information submitted will have to be stored by the platform for data management.

3.2.1.2 Data Management Module

This module is central to the BESP platform. It deals with the database access in both directions. It means that in this module is managed both the extraction of information to be displayed for the user (through the data visualization module) and the insertion of information in the main database (from the user – through data insertion module – and from the ENES and ENEB databases)

The BESP main database stores information for all the schools, questionnaires questions and answers, for all the indicators (explained in [chapter 3.2](#)), the obtained results and DEA scores and variable values (see [chapter 5](#)).

Most of this data is static and does not suffer any changes, but any process in the website will always go through the BESP database to extract the pretended information.

The external databases ENES and ENEB are both required to be annually published and are then incorporated in the in the platform with the sole purpose of extracting the information into the BESP main database.

3.2.1.3 Data Visualization Module

This module embraces all the functionalities and libraries required to transform the stored data into information ready to be displayed to the end user (i.e. graphs, lists, tables).

The details of the graphical transformation of data into graphs are detailed in the [section 4.3.1](#)

3.2.2 Physical Architecture

This section details the physical dependencies and layers interaction. Figure 19 details the vertical decomposition of the system.

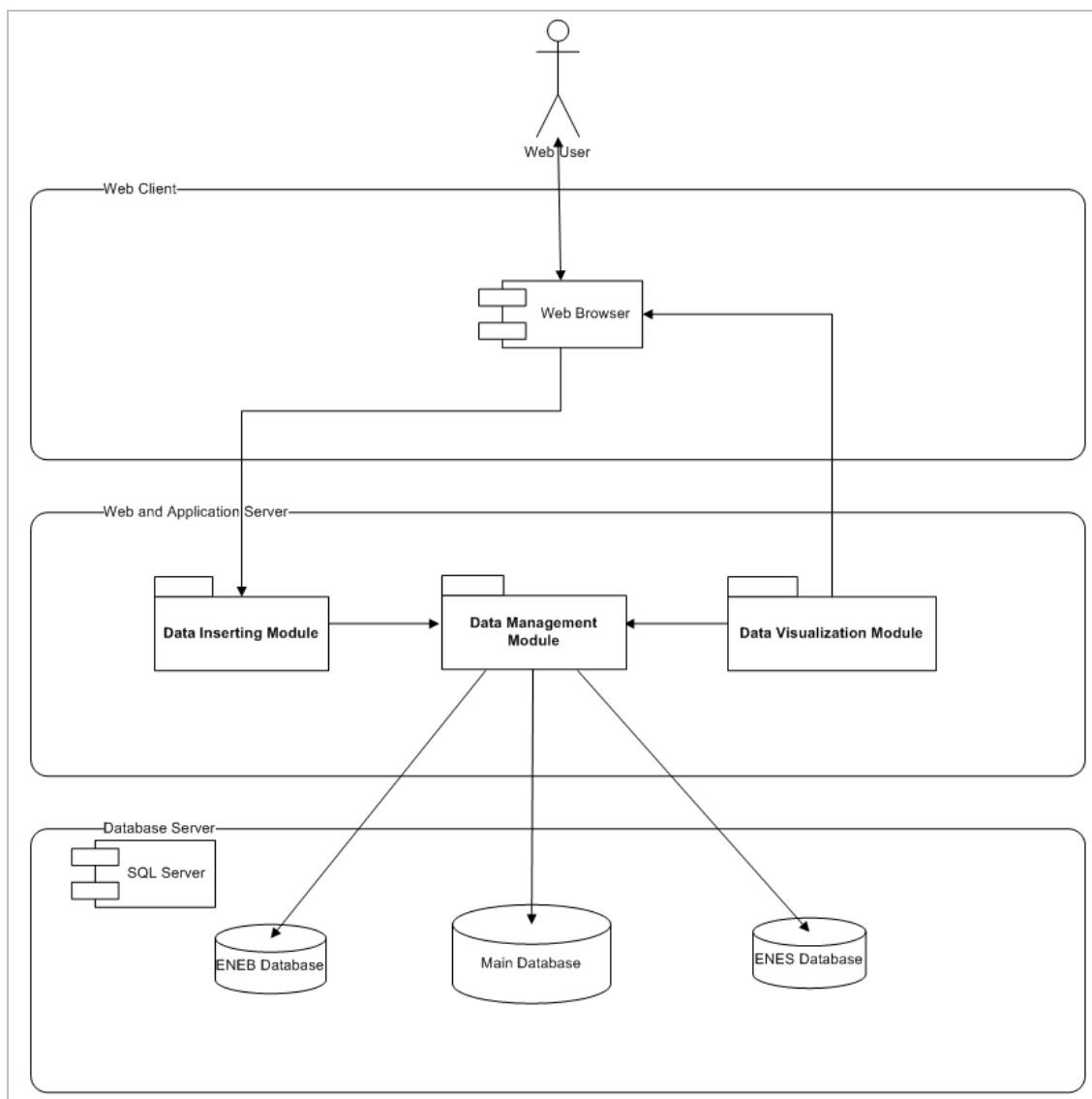


Figure 4 – Physical Architecture

The user has access to a machine that has an internet connection, so there is implicit a client server connection between the user's machine and, in this case the web server.

Web browser is the application that allows access to the web pages using the *http* protocol. The BESP platform is designed to work under the vast majority of web browsers and is tested in Internet Explorer 8 and Mozilla Firefox 3.

The business logic (all the modules above seen) is written in PHP, JavaScript and XML, and this middle layer communicates with the web client and the database server.

The database server embraces the BESP main database and the Ministry databases: ENES and ENEB. It is composed of the stored data, the management services and database access providing. The server is SQL Server 2000, a relational database server that produces the operations asked by the client (the Web and Application server).

There are two databases that BESP depends on: ENES (Exames Nacionais do Ensino Secundário) and ENEB (Exames Nacionais do Ensino Básico). These two databases are of public domain and made available online by the Education Ministry. In these databases is stored needed data by the BESP from the 9th grade national exams and the 12th grade national exams respectively. This data is essential for the Results Indicators (detailed in the section 3.2.2).

The main BESP database stores data gathered from the input of schools and from the Ministry Databases automatically through web requests. It is therefore compulsory for the good operation of the system that the Ministry keeps publishing annually the two databases.

The BESP main database is made of several tables of which the most important are here detailed.

- AnoControlo

To manage which year has data available and the questionnaires created

- Concelho

This table stores all counties and the district they belong to

- Diferenciador

To differentiate possible instances common indicators

- Distrito

Stores all the Portuguese Districts

- ENEBEscola

Stores data for each third cycle school (per year) retrieved from annual ENEB database.

- ENEBResultado

Stores data for third cycle national exams results (per year) retrieved from annual ENEB database.

- ENESEscola

Stores data for each Secondary cycle school (per year) retrieved from annual ENES database.

- ENESExame

Stores data for each of the Secondary cycle national exam per year retrieved from annual ENES database.

- ENESResultado

Stores data for Secondary cycle national exams results (per year) retrieved from annual ENES database.

- Escala

Stores the association between qualitative values and quantitative values (for analysis)

- Escola

Stores information of all Portuguese schools from the third and secondary cycle (according to ENES and ENEB). This tables stores per each school: the name; district, county and parish; address and zip code; the type of school (public / private); and the ENES and ENEB

- EscolaEficiencia

Stores the efficiency score for each school in each year

- Freguesia

Stores all the Portuguese parishes' names and the counties they belong.

- FreguesiaIIFAno

Stores the instruction index (IIF) per parish per year.

- Gama

Stores the minimum and the maximum for each qualitative range.

- Indicador

Stores every indicator in the BESP platform. For each indicator there is: indicator id; type of indicator; aggregate indicator; name; short name; benchmarking formula; minimum and maximum values; and public or private indicator;

- IndicadorVariavel

Stores the association between the indicators and the variables

- Inquerito

Stores the association between questionnaires and Schools, the year of the questionnaire and the submission state.

- OrigemVariavel

The origin of the created variable: ENES, ENEB, Questionnaire, INE or DEA

- Pagina

Stores the pages files path for redirection purposes

- Pergunta

Stores the questionnaire questions and the variables that correspond to the questions. Every indicator has a question associated as well.

- Resposta

For each questionnaire and question stores the answer and the temporary answer

- Resultado

For each questionnaire and indicator stores the calculated value (using data from the table Resposta)

- Utilizador

Stores the different users usernames, the passwords, their user types the information about their last login

- Variavel

Stores the variables id's, names and descriptions.

3.2.3 Logical Architecture

The logical architecture of the system is a three tier architecture that is often used to refer websites and web applications.

This application is divided in 3 layers consisting of:

- A Presentation Tier

This is the topmost level of the application. The presentation tier displays information and contents. It communicates with other tiers by outputting results to the browser/client tier and all other tiers in the network.

In this tier there is a single component, the *Web browser*. Because this is the layer that the user interacts with it means that there aren't any restrictions to the usage of the BESP platform other than having a computer and an internet connection.

- Application Tier/Business Logic

The logic tier is pulled out from the presentation tier and, as its own layer, it controls an application's functionality by performing detailed processing.

This tier consists of the 3 modules already explained. The data management module is central in this layer because it is the responsible for the communication with the databases. This module uses the Data visualization module to display the results and the Data Inserting module to deal with input information from the user to store in the database.

- Data Tier

This tier consists of Database Servers. Here information is stored and retrieved. This tier keeps data neutral and independent from application servers or business logic. Giving data its own tier also improves scalability and performance.

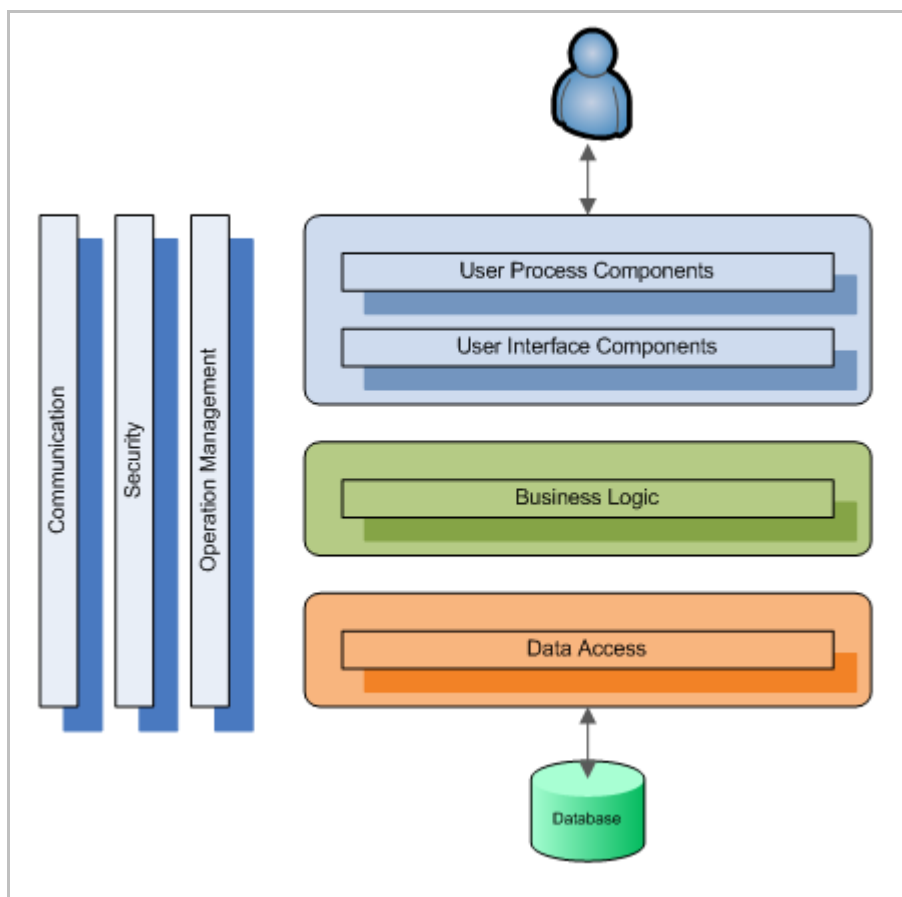


Figure 5 - Horizontal decomposition of the system

3.3 Technologies

3.3.1 Technological Revision

All developments of this project used the same languages and technologies to ensure the consistency of the final product.

Therefore the technologies used were PHP server (PHP language for the business logic and presentation tier), JavaScript language (business logic), CSS (presentation tier – styling the website), XML (business logic and presentation tier – used to produce the graphics), AJAX (Presentation tier), HTML (presentation tier) and SQL language (data tier) and SQL Server 2000(data tier – management of the database).

3.3.2 Data visualization

When a user accesses a page that requires data visualization (Restrict Benchmarking, Benchmarking, and Internal Evaluation), the indicators are divided into tabs, according to the categories they belong. Upon entering such a page a list of graphs for the indicators results of the

current tab are displayed (line graph, radar graph or column graph) or in the lack of results for a specific indicator, a message is displayed informing the user that there are no results for the particular indicator in selected year for the chosen school.

There are three possible graphs: line, column and radar (polar).

For the construction of the line graph it is required to know the indicator id, the school id (for pointing out its result), the year, the comparison method, the graph type (regular, inverted). Then it is possible to retrieve a list of the benchmarking results for the given circumstances. The values are then ordered increasingly if the graph type is regular, or decreasingly if the graph is inverted (e.g. when a higher score is indicating of worst performance like “% of dropouts”) and then processed and displayed.

The construction of column graphs (for longitudinal analysis) is similar, but with the exception that the data retrieved from the database only concerns one school so it is not required a year or a comparison method for this analysis.

The radar graphs, also called polar graphs, are only produced for indicators that are aggregated indicators (e.g. “Weighted average of Secondary level national exams results” is an aggregate indicator and it is composed of the 8 different averages for national exams courses). To produce this type of graph it is required to know the “sub-indicators” of the indicator that is being transformed into a graph.

For all these three graph types the same tool for graphic creation is used: XML/SWF Charts (XML/SWF, s.d.). XML/SWF Charts is a simple, yet powerful tool to create attractive charts and graphs from XML data.

To produce a graph it is only necessary to include a couple of files in the server and then create an XML source to describe a chart and then pass it to XML/SWF tool's flash file to generate the chart. The XML source is very easy to use and can be generated dynamically using any scripting language (in this case is generated with PHP).

This tool is very flexible allowing almost endless possibilities in graphs formatting. Among the functionalities it is possible to choose colours, fonts, line types, interactive mouse pointing, animations, customized labels and customized graph keys.

This tool offers no limitation in the creation and formatting of the graphics and is very extensively documented in the XML/SWF website. This tool is also usage free.

XML/SWF Charts makes the best of both the XML and SWF worlds. XML provides flexible data generation, and Flash provides the best graphic quality (XML/SWF, s.d.).

3.4 Interface

The most important thing when designing a website is its potential users. In this system is expected the users will typically be teacher, school board directors, parents and member of education organizations. These users are expected to be somehow proficient in the education sector but none is expected to be an informatics or web expert.

To produce a good webpage environment this system is very highly user-focused, meaning that the navigation in the site, the displaying of the results, the questionnaires, the reports, etc. are all very easy to understand and interact.

It is expected that users want to use the platform mostly for analyzing the provided information. Bearing in mind that fact, a particular care was taken towards displaying rankings list and graphics in the most quick and easy-to-read fashion.

It was taken into account that even designing the webpage to be as easy as possible to understand and navigate some users may feel lost or not knowing what the current page is supposed to be. For that purpose and information button  is placed in every page and every graph to help the user.

The BESP website layout is divided into 3 components: the navigation links (left column), the page body (right) and the user login box (left column). The login box and the navigation links are always displayed and allow the user the opportunity to access any main page and login/logout at any given moment. The body section is where the page contents are presented.

There are three different types of users: Guest, Registered User and Administrator. Each one of these three users has different accessibility levels. A guest will have the opportunity to access public domain information like rankings and a restricted (only a set of indicators) version of the benchmarking utility. A guest can as well read about the project description, indicators set, benchmarking methodology and DEA methodology, therefore understand a little more of what the platform potentialities.

A registered user is always a teaching establishment. This type of user will obviously have access to everything the guest has and furthermore will have the opportunity to use the benchmarking page with no restrictions, the internal evaluation page, the DEA page, answer the yearly questionnaires and even the opportunity to produce a user-defined report.

The administrator has the opportunity to export the some indicators results and produce different models for Data Envelopment Analysis.

This website is divided in different pages with three main sections that have different access levels. The following description of the pages division can be seen as well in a paper written during the course of this Master final project. (See appendix A)

3.4.1 Public Area

These next three pages are the only available options for a non-registered user (guest).

- **Home**

This is the BESP main page. There is an explanation what it the mission of this project, and its functionalities. An organogram was designed (as seen in Figure 8) with links that show how the website is organized (and allow to quickly change to the desired page), what features a registered and a guest user can access, and quickly allows the user to access the indicators set, the benchmarking explanation, the DEA explanation and the rankings page.

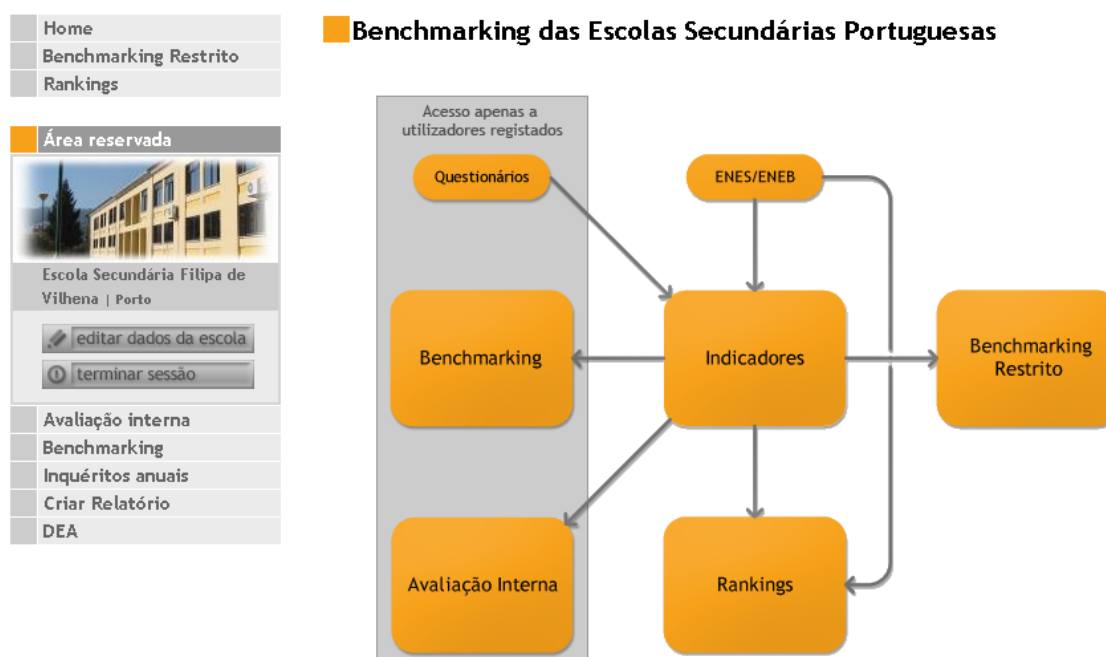


Figure 6 - Home page

- **Restrict Benchmarking**

In this page the user can compare any given school with the rest of the schools nationwide (or subgroups of those – same county, same district, nationwide, same or inferior IIF (Instruction Index per Parish) and the same “type” (public / private).) in a number of indicators that were built based on public data from the ENES and ENEB databases. In order for the user to see some results first it is mandatory that a school is chosen. For a quick lookup, schools are divided in district and county, so finding a particular school is very easy. After choosing the school the user chooses the school year and the comparison option. After hitting the “update data” button the page displays the line graphs for indicators that are base in public domain data: IIF in the Context tab and 7 indicators in the Results tab. It is possible to access the printing utility.

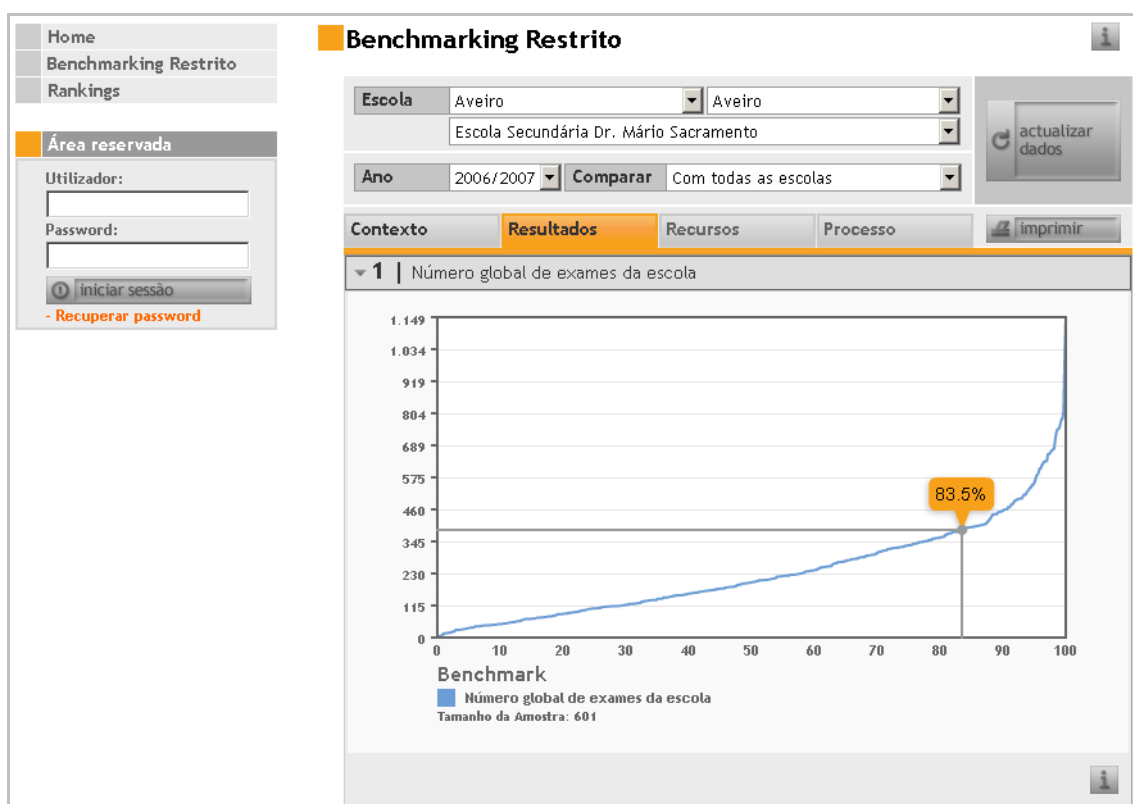


Figure 7 - Restrict Benchmarking

• Rankings

In this page the user can elaborate ordered lists of schools from the national exams database – ENES. For the elaboration of these rankings are considered all the internal students that do the national exam for the first time (retakes are excluded because different exams cannot be used for the same comparison). Beyond that the ranking to produce can comply with a series of other criteria according to the user interest (e.g. public schools ranking, ranking of same county schools, ranking of schools for a given course, ranking of school for the Top 8 courses, etc.). The user might even select a school in particular and that school will appear highlighted in the ordered list. In some cases the selected school may not fit the criteria selected and for those cases the school will still appear highlighted but with a null position in the ranking.

The visible fields in the ranking list are: Number of exams, Final internal result (CIF), average exam result (“média exame”), Final distributed result (CFD), Difference between exam and CIF result (“exame - CIF”) and standard deviation of national exams results. Ordering can be done ascending or descending for every one of these fields (except standard deviation).

#	Escola	Média Exame	Nº Provas	Média CIF	Média CFD	Exame - CIF	Desvio Padrão
1	Colégio Cedros (Porto)	14.25	36	14.92	14.89	-0.67	3.64
2	Externato Horizonte (Porto)	13.28	29	15.76	15	-2.48	4.09
3	Colégio Internato dos Carvalhos (Porto)	12.7	261	16.05	15.15	-3.35	3.37
4	Colégio Nossa Senhora do Rosário (Porto)	12.51	435	15.86	14.95	-3.34	3.64
5	Colégio Luso-Francês (Porto)	12.46	322	15.9	14.96	-3.44	4.06
6	Escola Secundária Filipa de Vilhena (Porto)	12.36	714	14.05	13.63	-1.69	3.95
7	Externato Ribadouro (Porto)	12.33	921	16.36	15.26	-4.03	4.16
8	Grande Colégio Universal (Porto)	12.22	141	14.42	13.87	-2.2	3.98
9	Escola Secundária Cavaleiros de Outeiro (Porto)	12.02	1102	14.30	13.48	-2.27	3.92

Figure 8 – Rankings page

3.4.2 Restricted Area (Registered Users)

This set of pages is only available for users registered in the BESP system. The information presented in these pages is strictly confidential and therefore accessed by no one other than the school user. These users may still access the public area pages.

- **Edit School Data**

This page is only accessible to registered users. It allows the school to reset the password and edit the school location, contacts and school avatar.

By choosing the parish in which the school is located the comparison method between schools with similar IIF can be more effective. When the universe of Portuguese secondary schools has filled in this option the comparison will be 100% effective.

Home

Benchmarking Restrito

Rankings

Área reservada



Escola Secundária Filipa de Vilhena | Porto

editar dados da escola

terminar sessão

Avaliação interna

Benchmarking

Inquéritos anuais

Criar Relatório

DEA

Editar dados da escola

Nova password:

A nova password deverá conter pelo menos 8 caracteres e ser constituída por letras e números.

Nova password

Confirmar password

Localização da escola

Morada

Rua...

Código postal

4405-832

aldoar

Freguesia

Selecione a freguesia da escola:

Concelho

Porto

Contactos da escola

Telefone da escola

227131323

e-mail da escola

diogoborges@hotmail.com

Imagem da escola

Formatos suportados: PNG, JPG, GIF e BMP. Tamanho máximo: 100 KB.

Dimensões recomendadas (em pixels): 200 x 80.

Ficheiro

Browse...

submeter

Figure 9 - Edit School Data

34

- **Internal evaluation**

This page is only accessible to registered users. In this page the user can see each one of the indicators mentioned in section 3.2 in the form of column graphs (explained in chapter 3.3.3). The indicators are divided in four tabs corresponding to the four different groups of indicators: Context, Results (Scientific-Humanistic and Professional programmes), Resources and Processes. The reason for this sub-tab division in the Results tab is that the Professional Programme indicators are only produced from data provided by schools).

This page will allow an over-the-years analysis of how the school is performing in every indicator. This way it is possible for school to check whether it is or not fulfilling their improvement goals. There is the possibility to use the “Print” functionality.

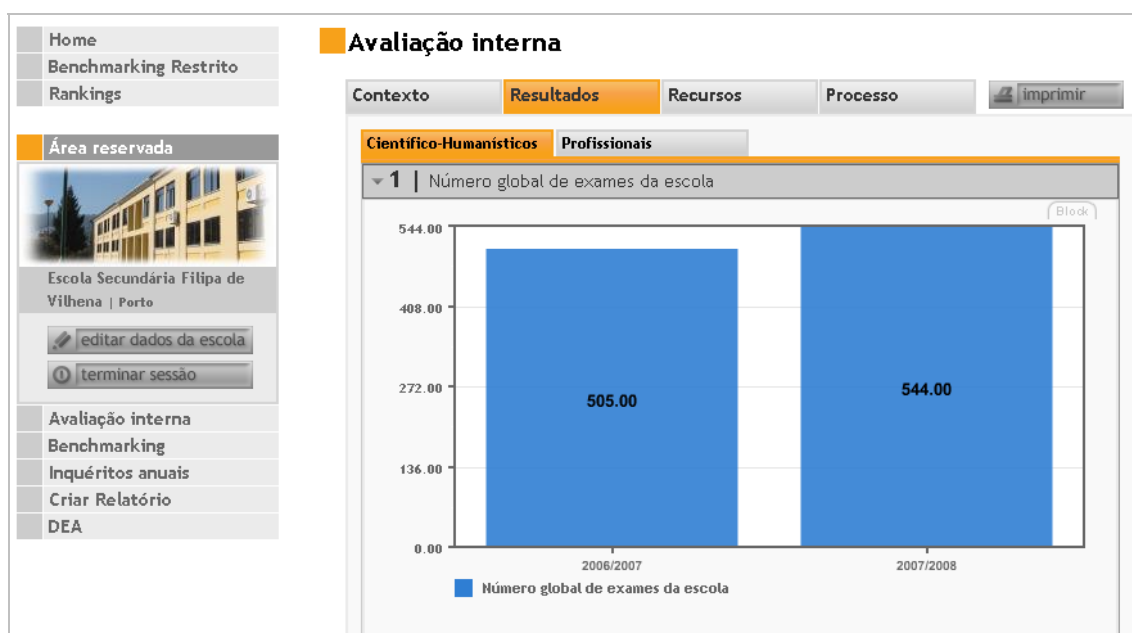


Figure 10 - Internal Evaluation page

• Benchmarking

This page is only accessible to registered users. In this page the user can see each one of the indicators mentioned in section 3.2 in the form of line graphs (explained in chapter 3.3.1). The indicators are divided in four tabs corresponding to the four different groups of indicators: Context, Results (Scientific-Humanistic and Professional programmes), Resources and Processes. This page is similar to the Restrict Benchmarking page with the difference that there are no restrictions in this page. In this page the user will not choose any school at will. This page is produced to analyze the school affected to the user.

The school will still have to decide which year to see results and which comparison method to use. The Print functionality is available in this page as well.

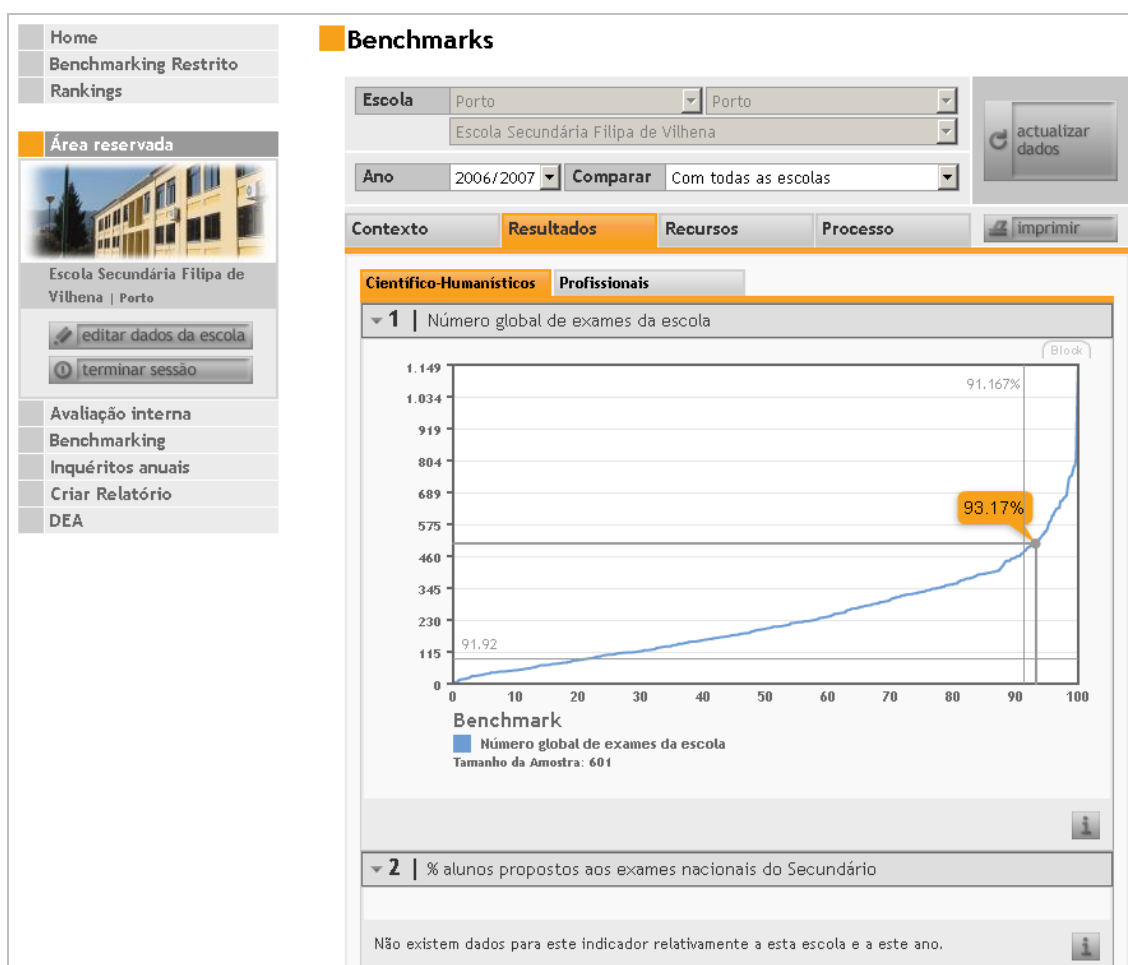


Figure 11 – Benchmarking

• Printing Graphs

There are two similar printing functionalities: for benchmarks (restrict or complete version) and internal evaluation.

This page will ask the user to select the indicator or the set of indicators the user would like to arrange for a printing format.

Checkboxes can be checked or unchecked and indicators that have sub indicators have an expansion option (e.g. indicator 3 in Fig. 14).



Figure 12 - Printing page

This page is only accessible by registered users. In this page the user can see each one of the indicators mentioned in section 3.2 in the form of line graphs (explained in chapter 3.3.1). The indicators are divided in four tabs corresponding to the four different groups of indicators: Context, Results (Scientific-Humanistic

- **Annual Questionnaires**

The annual questionnaires page is only accessible to registered users. Questionnaires are created on a yearly basis for schools to respond. The information used in this project is either of public domain (Education Ministry, National Institute of Statistic) or collected through questionnaires.

In the main page of the Annual questionnaires it can be seen the four possible questionnaire states:

- **Opened Questionnaires**

These questionnaires are the ones created by the website that have not been addressed by the school. This is the default state of a questionnaire when it is created.

- **Finished Questionnaires**

These questionnaires are the ones that the user opened and submitted. If a user opens the questionnaire for the first time, fills whatever is possible and submits it then the indicators results are automatically calculated. However a questionnaire may be finished if it is re-submitted and the re-submission accepted by the administrator.

- **Re-Opened Questionnaires**

These are questionnaires that are opened, submitted and once accepted, then opened again. A questionnaire will maintain this state if the user just uses the option “Save” instead of submitting.

- **Edited questionnaires waiting to be validated**

The submission of the questionnaires is, as mentioned before, controlled by the administrator. This is done to prevent users to abuse ethics and re-submitting questionnaires several times in order to see different results. This does not oblige the user to fill the questionnaire all at once, it is possible to “Save” the questionnaire and submit at a later time.



Figure 13 - Questionnaire States

If a questionnaire is re-opened the user will be notified that the current questionnaire is re-opened and therefore dependent of administrator approval once submitted. The previous data answered is automatically filled in the answer fields with the latest given answer.

The screenshot displays the BESP interface. On the left sidebar, there are links for Home, Benchmarking Restrito, Rankings, and a reserved area (Área reservada) for Escola Secundária Filipa de Vilhena | Porto, which includes buttons for 'editar dados da escola' and 'terminar sessão'. Below this are links for Avaliação interna, Benchmarking, Inquéritos anuais, Criar Relatório, and DEA. The main content area features a green notification bar at the top stating 'O inquérito foi reaberto. Os novos dados introduzidos terão agora que ser validados pela administração do BESP.' followed by the title 'Inquérito | 2006/2007'. Below the title are tabs for Contexto, Resultados, Recursos, and Processo. The Contexto tab is active, showing a questionnaire with four questions: 1. Number of secondary students (text input, value 150), 2. Average parental education (radio buttons, '6º ano (6 anos)' selected), 3. Percentage of students in professional courses (text input, value 0.3), and 4. Percentage of students in scientific-humanistic courses (text input, value 0.7). A green bar at the bottom of the form states 'Este inquérito foi reaberto.' and contains buttons for 'sair', 'gravar e sair', and 'submeter'.

Figure 14 - Re-opened questionnaire

- **Report Creation**

This functionality was developed under the suggestion of a number of schools in an early stage of monitoring the website implementation with school boards members.

There is no limit to the number of reports that the user may create, though it is required to save the document before creating another report, otherwise the previous is lost.

The report is user define which means that the information contained in the report will be totally defined by the user: the indicators among the total set that the user wants to have in the report. The user is required to select the school year and the comparison method for the report creation and therefore any report will be subject to these two.

The graphics contained in the report are divided in the 4 different categories of indicators: Context, Results, Resources and Processes, preceded by a small introduction.

Though this functionality is similar to the printing page, the difference is that this option creates a document that can be very useful for distribution. Distributing a user-defined document (printed or digital document) prevents the possible security breach of giving the login/password pair to other people.

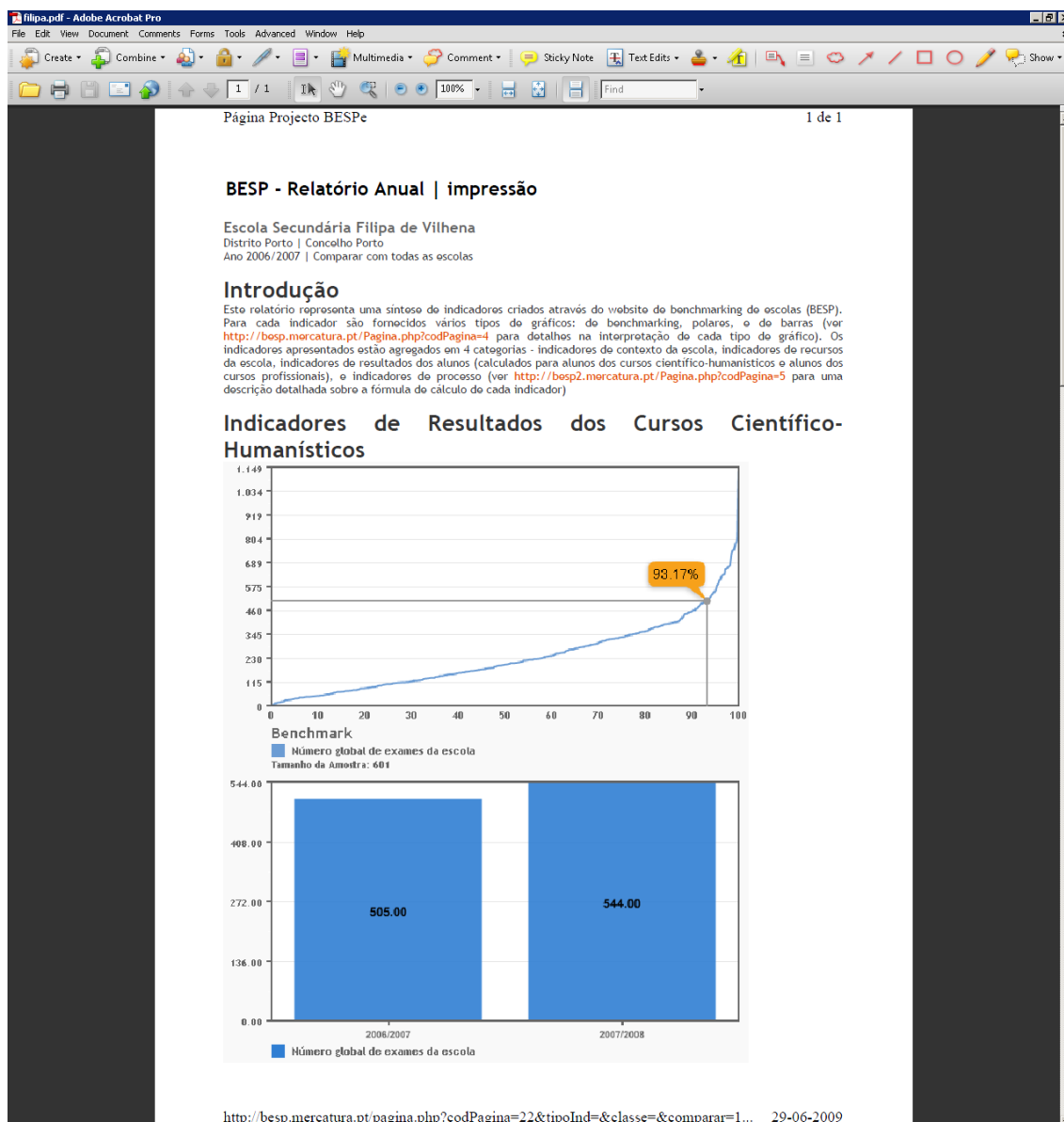


Figure 15 – Example of a pdf report

3.4.3 Administrator Area

These pages are only accessible by the administrator.

- **Export Data**

This page is only accessible to the administrator. By selecting the school year and the indicators a tab-separated text file is produced with the corresponding information. This feature will allow for different analysis of the information contained in the BESP site (other software like MS Excel, EMS, etc...)

[illegible]

Figure 16 - Tab separated text version of the results

- **DEA setting**

This page is only accessible to the administrator.

Is it the purpose of this page setting which parameter will be used in the DEA model to analyze school performance scores. The administrator can choose the inputs and the outputs to be taken into consideration for the DEA model. It is required to choose a year.

- **Data management**

There is a process that has to be done each year upon the publishment of the ENES and ENEB databases. This is a process is parallel to the BESP platform, so there are not restrictions to the platform when this process is taking place.

- Each year the following steps have to be performed:
- Download the zip ENES and ENEB databases files ([http call](#))
- Unzip both files (Java function)
- The files are opened (JDBC ODBC – Microsoft Access driver)
- New schools from the databases are created
- Existing schools are cross-checked with the newly added schools
- New questionnaires are created
- The variables are created and the results calculated

Cross-checking schools was a task that had to be done for all the years since 2006 for the platform in order to avoid duplicates of schools in the system. This cross-checking has to be

performed annually because over the past years many schools changed their names and therefore could be interpreted as different schools in the system. With the improvement of a function to recognize similar patterns in schools names was possible to correctly match all schools in the system with their annually updated names.

3.5 Performance Indicators

Performance indicators are metrics used to help school define and evaluate how successful it is. This can be done strictly assessing the indicators results or by using the results to compare with other schools. A set of performance indicators was defined and divided in 4 categories.

The several performance indicators are divided in 4 different categories: Context, Results, Resources and Processes.

3.5.1 Context Indicators

These indicators concern the social and economic environment of the school. They are calculated with information gathered in the annual school questionnaires and information from the Portuguese National Statistic Institute (INE). “Average instruction level per parish” is the only public indicator.

- Average instruction level per parish
- Parents average scholarship
- Ratio of economic deprivation
- % of students in the Professional Courses with external tutorship
- % of students in the Scientific-Humanistic Courses with external tutorship

3.5.2 Results Indicators

Result indicators are calculated from the schools’ students’ performance. Part of this information is published by the Education Ministry and the rest is gathered with schools’ annual questionnaires.

Scientific-Humanistic Programme

- Global success percentage in the 10th grade
- Global success percentage in the 11th grade
- Global success percentage in the 12th grade
- Portuguese 9th grade national exam average classifications
- Math 9th grade national exam average classifications
- Secondary level CFD results(weighted average between internal grade and national exam) average on:

- o Portuguese
 - o Math
 - o Biology and Geology
 - o Physics and Chemistry
 - o History
 - o Economy
 - o Geography
 - o Math applied to Social Sciences
- Secondary level national exam results average on:
 - o Portuguese
 - o Math
 - o Biology and Geology
 - o Physics and Chemistry
 - o History
 - o Economy
 - o Geography
 - o Math applied to Social Sciences
- % of students proposed to Secondary level national exam on:
 - o Portuguese
 - o Math
 - o Biology and Geology
 - o Physics and Chemistry
 - o History
 - o Economy
 - o Geography
 - o Math applied to Social Sciences
- % of students that failed the course of:
 - o Portuguese
 - o Math
 - o Biology and Geology
 - o Physics and Chemistry
 - o History
 - o Economy
 - o Geography
 - o Math applied to Social Sciences
- Global number of exams in school

- % of students proposed to Secondary level national exams
- Weighted average of 9th grade national exams results
- Aggregated value of 9th grade national exams relative weighted average
- Weighted average of Secondary level national exams results
- Aggregated value of Secondary level exams relative weighted average
- Weighted average of Secondary level CFD's
- Aggregated value of Secondary level CFD's relative weighted average
- Global success rate
- Secondary level failing rate
- % of students to finish the secondary level in 3 years
- % of students that finish enter college
- % of students that are employed after 6 months of finishing the secondary level
- % of drop-outs

Professional Programme

- Number of students registered in the 1st year
- Number of students registered in the 2nd year
- Number of students registered in the 3rd year
- Number of students that finish the Professional Course in the current school year
- Number of drop-outs
- Number of students to finish the Professional Course in 3 years
- Number of employed after 6 months of finishing the Professional Course

3.5.3 Resources Indicators

Resources indicators concern school's teachers, materials, costs and revenues. The data is entirely provided by the school therefore these indicators results are not public.

- Teachers average age
- Teachers' average number of teaching years
- Number of teachers per student
- Number of teaching staff per non-teaching staff
- Number of computers per student
- State budget revenue per student
- School's own revenues per student
- External financial contributions
- Teaching staff wages per student

3.5.4 Process Indicators

Process indicators concern schools' practices and processes. The data is entirely provided by the school therefore these indicators results are not public.

- Extra-Curricular projects
- Participation in extra-curricular projects
- Embracing community support
- Partnerships
- Teachers motivation
- Internal and External Evaluation
- Parents participation
- Discipline systems
- Directive team stability
- Facilities and equipments
- Excellence board
- Selection of entering students
- Group Work
- Training courses
- Aggregated IGE evaluation
- Teachers' average number of teaching years

The school performance measured in each one of these indicators is displayed in benchmarking graphics where schools can see their benchmark percentile.

The formula for the percentile is $p = \frac{100 \times (k - 1)}{(n - 1)}$ where n is the number of schools and k is

the school rank in a given indicator. This percentile regards a comparison universe that is user-defined. The possibilities for comparison may be: same county, same district, nationwide, same or inferior IIF (Instruction Index per Parish) and the same "type" (public / private).

3.6 Graphs

For example purposes it is assumed a school wants to know how it ranks (for its students under the course of Scientific-Humanistic) with other schools in the weighted average of Secondary level national exams results and weighted average of Secondary level CFD's (only considering internal students). The result available for the school is illustrated in the following graphics.

3.6.1 Line Graph

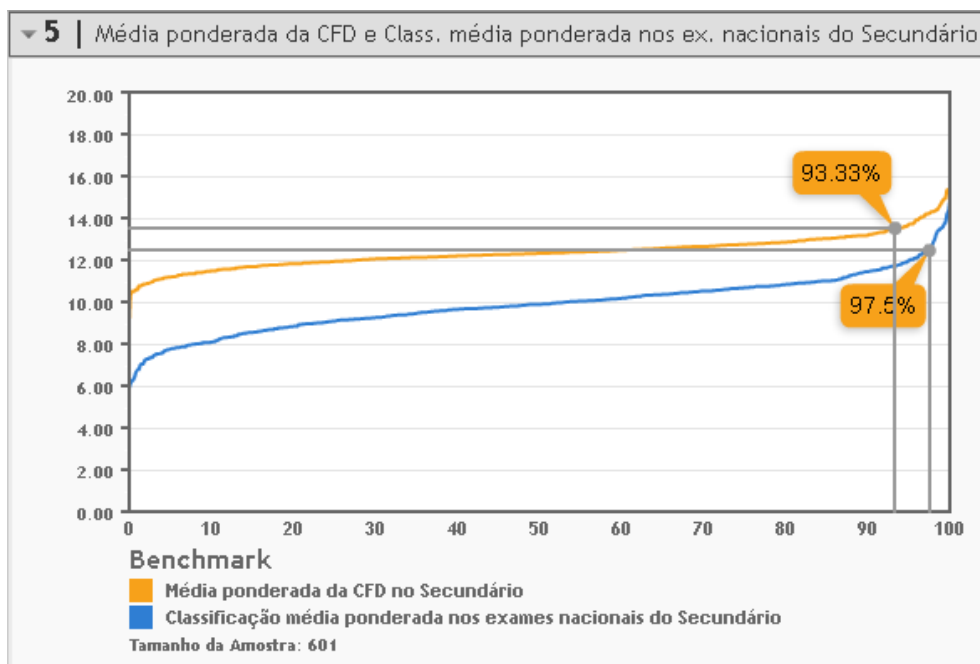


Figure 17 - Line Graph

In this graph every school in the country that fit the criteria are placed in crescent order of both it is weighted average of Secondary level national exams results (blue line) and weighted average of Secondary level CFD's (orange line). The line in the graphic represents the way schools are ordered. This particular school has a 12.45 average for the exams, placing the school in the 97.5% percentile meaning that 97.5% of school nationwide had worst averages and 2.5% had better averages. CFD wise this school has an average of 13.51 placing it at the 93.33% percentile.

This type of line graph is displayed for every school's performance indicator.

In this particular case it is worth noticing that the CFDs averages are way superior to the national exams averages meaning that the internal grades were undoubtedly higher than the national exams grades. This particular graphic will provide the school information that would not be possible without benchmarking: the fact that tough the CFD average is higher than the national exams average comparing to other schools the school performance in CFD grades were worst than the national exams.

3.6.2 Radar Graphs – Aggregation



Figure 18 – Radar Graph

This graph is called radar graph and is constructed to simultaneously show the benchmarking values for each one of the contributing (for the corresponding line graph) indicators. For each number in the graphic there is a key to show which indicator it refers to.

It is possible to notice that, for the Portuguese national exam the benchmarking value is close to 100% while for the Economy national exam the benchmarking value is close to 60%.

Once again, this particular case is very interesting because it allows in a quick one sight the overall discrepancies between national exams and CFDs of each of the 8 contributing indicators (disciplines)

3.6.3 Column Graph – Relative and Absolute values for evolution

Beyond the earlier mentioned graphs the website also displays graph to analyze the school evolution during time for each indicator. This way it is possible for school to check whether it is or not fulfilling their improvement goals. The results in the following two graphs are representative of the “weighted average of Secondary level national exams results” and “aggregated value of Secondary level exams relative weighted average”. This second indicator is a relative weighted average which means it is normalization (school average / national average). This type of indicator is very important because of the fact that the yearly results can be seriously dependent of the exam (difficulty wise). Therefore a lower average result in a given year does not necessarily mean that the school performance was worse.

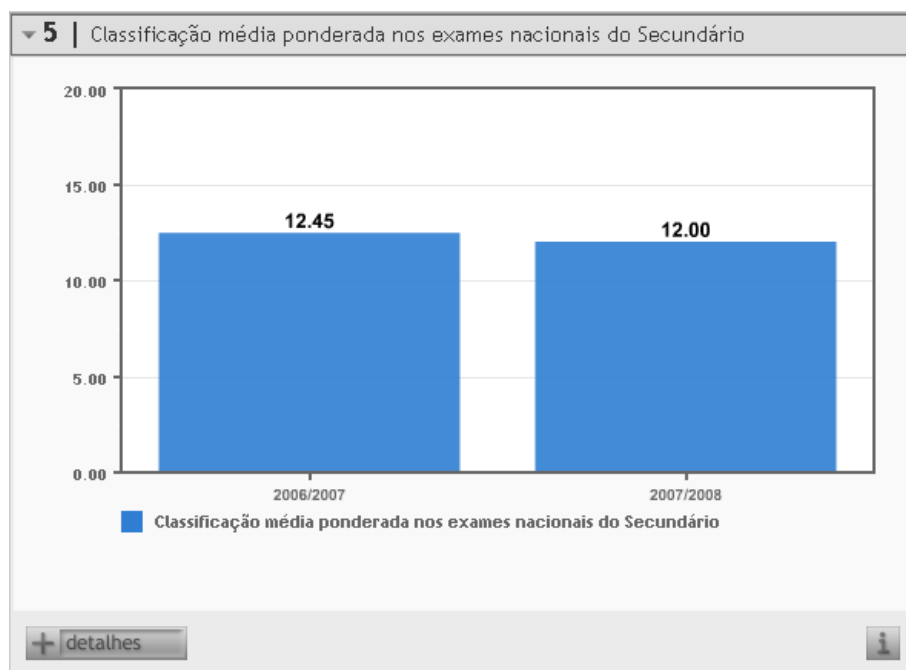


Figure 19 - Column Graph – Absolute Values

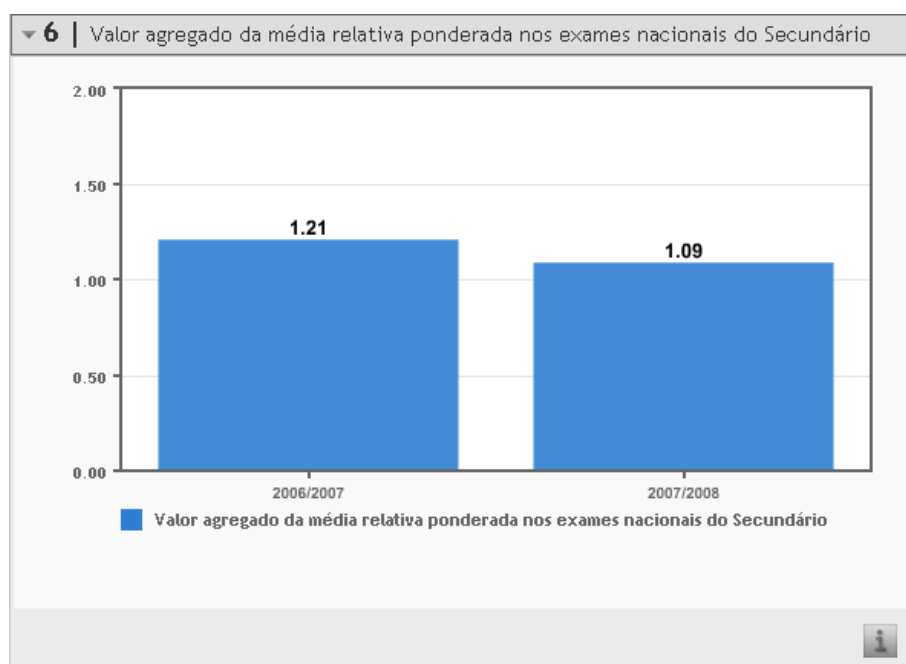


Figure 20 - Column Graph – Relative Values

It can be noticed in Fig.6 that from the school year of 2006/2007 to the school year of 2007/2008 the national exams results average dropped from 12.45 to 12.00. In Fig. 7 though it can be seen that when comparing to the national average the school really had a worse performance than the previous year (this is not directly connected to the absolute average dropping – easier exams can improve the

school average but still the school performance may not be as good when comparing to the universe of schools). Because it is a normalization the value of 1 in Fig.7 would mean the school has the same average as the national average. Each cent above or lower means a difference of a percentage point above or below the national average.

These column graphs are produced to every performance indicator though the normalization only applies to exams or CFDs.

3.7 Conclusions

This BESP platform has a set of 4 categories of performance indicators each one regarding different key aspects of the education process: Context, Results, Resources and Processes. The identification of some new performance indicators and the dropping of some unfeasible performance indicators made this global set of indicators more appropriate to the reality of Education Performance analysis in Portuguese Secondary Schools.

For each performance indicator is displayed at least one type of graph, and in some cases 3 types of graphs are displayed for a single indicator allowing the user to analyze the data with several different perspectives: comparing to other schools – external evaluation; comparing the school with other years – internal evaluation (longitudinal analysis).

The original platform and the platform as it is now at the end of this project are substantially different. Though the main architecture of the platform was maintained the navigation and the display of the results suffered major improvements.

The improvements and the implementations on the platform made this platform much more user-friendly, and the system testing and validation of the results contributed for a better assurance of the results accuracy and a bigger acceptance of the site.

Among the key aspects that this project contributed to a better platform are:

- The new ranking page – fully customizable and with a different design
- The graphs display – graphs were changed to better fit the expectations of the schools
- The production of a digital file (PDF) report – allows a better divulgation of the results inside the school.
- The home page was carefully designed, implemented and tested among possible users to respond to the needs of the user and to be a better introductory page as well.

These core aspects contributed to a system that fits better the web usability standards and therefore result in a better experience for the user.

4 DEA Implementation

In this chapter is described the Data Envelopment Analysis implementation on the BESP website, i.e. the integration of a performance evaluation model based on DEA in the schools benchmarking website. This feature was not available previously and was completely developed within this project.

4.1 Introduction

Analyzing the BESP website displayed results, it is possible to have a multi-dimensional view of how the school is performing (i.e. for each indicator, or even for each indicator category it is possible to have a broad view of school performance). It is possible to say that a school is performing well in the Result category of indicators, but to say that that school may be seen as “performing” better than other schools with lower benchmarking results is to ignore the complexity of the education sector. One should not compare only the output measures of a school disregarding the “inputs”, e.g. the students’ capacities upon entrances in the school the socio-economic environment of the students or the school resources.

“Education is a service that transforms fixed quantities of inputs (that is, individuals) into individuals with different qualities.” (Hanushek, 1986)

For that reason it is important to produce a single metric to fairly and rigorously evaluate schools performance. The methodology chosen was Data Envelopment Analysis.

DEA is a methodology that allows the assessment of a Decision Making Unit (DMU) performance in the processes of using a set of resources (inputs) to produce a set of results (outputs).

This is a comparative (relative) evaluation which means that the DMUs (schools) are analyzed in comparison with other DMUs in a set of variables previously chosen for inputs and outputs.

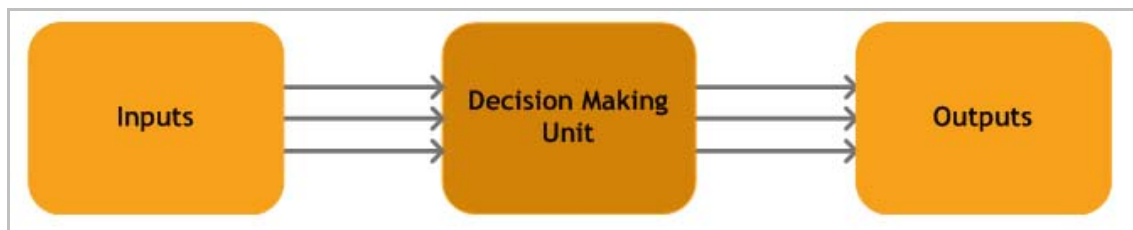


Figure 21 - Production Process

This methodology only considers part of the indicators in the BESP indicators set: a selection of the most important factors for assessing school performance was made.

The performance measure is defined as the ratio between the measured output and the maximum possible output (according to all the other observed values), for a given set of used resources (inputs).

DEA “identifies a subset of efficient ‘best practice’ DMUs and for the remaining DMUs, the magnitude of their inefficiency is derived by comparison to a frontier constructed from the ‘best practices’. DEA derives a single summary measure of efficiency for each DMU. For the inefficient DMUs, DEA derives efficient input and output targets and a reference set (or peer group), corresponding to the subset of efficient DMUs to which they were directly compared.” (Johnes et al, 2007)

Among DEA benefits are:

- no need to explicitly specify a mathematical form for the production function
- proven to be useful in uncovering relationships that remain hidden for other methodologies
- capable of handling multiple inputs and outputs
- capable of being used with any input-output measurement
- the sources of inefficiency can be analyzed and quantified for every evaluated unit
- Inputs and outputs can have very different units

DEA will provide a measure for efficiency for the universe of schools (0-100%) and for those schools that are not efficient (less than 100% score):

- DEA will define performance improvement targets for each input or output
- DEA will allow the identification of benchmarks (i.e. DMUs that are the example of good optimum performance)

For example purposes let's consider a small example a small sample of 4 schools and consider as input the average results upon entering the school and as for outputs the average results at the end of the Secondary school and the percentage of students finishing the secondary cycle in 3 years.

	INPUT	OUTPUTS	
	Average on entry	% of students finishing in 3 years	Average on exit
A	11.42	0.49	10.55
B	9.99	0.34	11.09
C	10.32	0.29	10.81
D	11.06	0.35	10.13

Table 1 – Example data for DEA exercise

It is possible to represent these schools in a scatter like graph in which the horizontal axis is $\frac{\text{LeavingAverage}}{\text{EntryAverage}}$ and the vertical axis is $\frac{\text{FinishingIn3Years}}{\text{EntryAverage}}$.

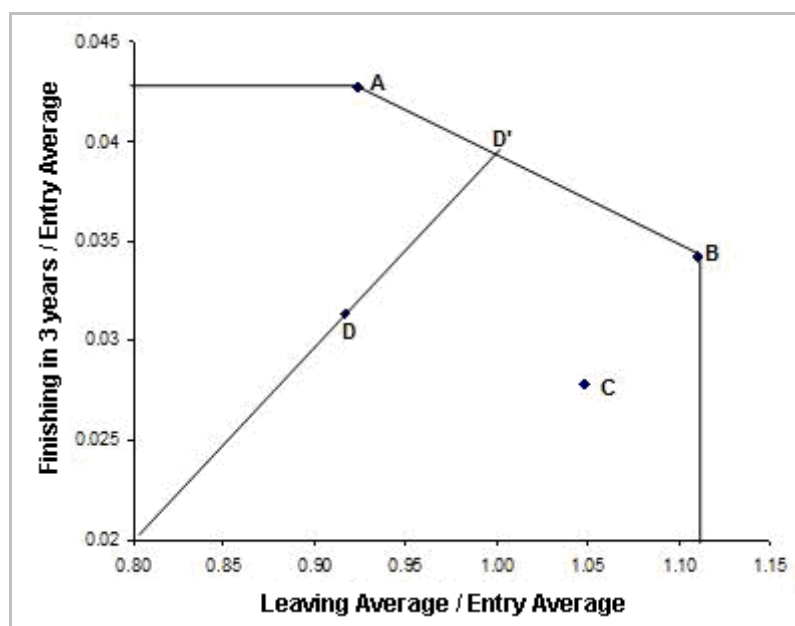


Figure 22 – Projection to frontier

From this graphic is possible to see two schools in the efficiency frontier (100% efficient): A and B. This is explained by the fact that among the school universe there is not any other school with better output per input unit. Considering the two different outputs, school A has the highest relative

percentage of students finishing in 3 years (vertical axis), while school B has the highest relative value for leaving average results.

School *C* and *D* are examples of inefficient schools (both these school will have efficiency scores below 100%). When comparing school *D* with efficient schools (*A* and *B*) it is possible to note that for the given average result on entry, this school students should have higher results at the end of the secondary cycle and/or a higher percentage of students finishing the Secondary in 3 years.

It is fair to say that schools *A* and *B* are school *D* benchmarks (schools that produce more outputs per input unit). Knowing the efficient frontier it is also possible to assess school *D*'s targets. This is the quantification of how inefficient the school is. To know how better the school can perform is to look at the distances OD' and OD (O being the origin of coordinates).

This model is output-oriented so the targets will be improving the outputs, while maintaining the inputs. School *D* target is to achieve leaving average results of 10.95 and percentage of students finishing the Secondary in 3 years of 38%. (Ribeiro, 2008)

4.2 The DEA Model

The DEA model used in this study is an output oriented model. While it is perfectly reasonable to assume that every school wants to make the best out of their students' achievements given the existing resources, it is out of the scope of the Secondary School the attempt to try to modify the existing resources (student related and socio-economic related).

The model presented here is known in the DEA literature as the BCC model (Banker, Charnes, Cooper, 1984) or VRS (Variable Return to Scale) model. This model was selected given the particular features of the inputs and outputs to be specified for school evaluation. Those consist on normalized indicators expressed as percentages or averages. These indicators allow schools of different sizes (scales) to be evaluated in the same model

$$\text{Maximize } \beta_0 \tag{1}$$

$$\text{Subject to: } \sum_{j=1}^n \lambda_j y_{rj} \geq \beta_0 y_{r0}, r = 1, \dots, s \tag{2}$$

$$\sum_{j=1}^n \lambda_j x_{ij} \leq x_{i0}, i = 1, \dots, m \tag{3}$$

$$\sum_{j=1}^n \lambda_j = 1 \tag{4}$$

$$\lambda_j \geq 0 \quad (5)$$

Where x_{ij} represents the input i for the school j and y_{rj} represents the output vector position r for the school j . n is the number of schools to present in the model, r is the number of outputs and s is the number of inputs.

y_{r0} represents the output r for the current school and x_{i0} represents the input i for the current school as well.

The school targets are given by

$$y_{r0}^T = \sum_{j=1}^n \lambda_j \times y_{rj} \quad (6)$$

This model will produce values for β_0 that are higher than 1 for inefficient schools and 1 for efficient schools, so the efficiency score for each school will be actually given by $\frac{1}{\beta_0}$.

4.3 Selection of inputs and outputs

This Project studies all the teaching establishments in Portugal Secondary Education. This is to say around 600 Secondary schools and close to 1500 when counting all schools including the Basic cycle.

Since the school year of 2001/2002 that the national exams results of the secondary cycle are made available to public through a database format. For the basic cycle national exams this databases were first published in 2004/2005.

For the analysis of school performance the sample of schools were reduced to the ones following the following requirements:

- Schools having at least one national exam of the Secondary Cycle
- Schools having at least one national exam of the Basic Cycle

The national secondary exams considered were the ones done:

- In the first phase of the exam (Re-takes and second phase excluded).

For comparison purposes the object of comparison has to be the same. One cannot compare two different exams for the same course.

- By internal students.

A student can apply for the national exam without attending classes or in some strategic cases the student may be advised to cancel the registration in the course before applying to the exam, therefore being considered “auto-proposed”.

- For the courses of Portuguese, Math, Biology and Geology, Physics and Chemistry, History, Economy, Geography and Math applied to Social Sciences.

These courses are the top 8 course with more exams taken in last 3 school years (since 2005/2006) so they were an obvious choice.

- By student under the following programmes: 60 – Science and Technology, 61 – Socio-economic Sciences. 62 – Human and Social Sciences, 63 - Languages and Literatures, 64 – Visual Arts.

These 5 programmes broadly represent a high percentage of the students attending general courses.

4.3.1 A recommendation

Table 2 summarizes the performance indicators chosen for input and output variables to be used in the DEA model for the Scientific-Humanistic programme. These set of variables is the recommendation set that would produce a very complete model for performance evaluation of schools.

Inputs	Outputs
Student related	Average scores on exit on national exams (secondary cycle)
Average scores on entry on national exams (basic cycle)	% students entering public higher education
Socio-economic related	% students that completed secondary education in 3 years
Parent’s average number of years in school	% students that did not abandon secondary education
Ratio of students not subsidized by the state	% of students proposed to the national exams

Table 2 – Input and Output variables for Scientific-Humanistic programme DEA

4.3.1.1 Inputs

The first input variable is related to the students. It is intended to reflect students’ academic capabilities when they are beginning the Secondary cycle. To fairly assess the student’s academic capabilities the results are taken from the 9th grade national exams (Portuguese and Math). The cost of

choosing this the national exams as the metric is that the school sample has to be reduced. It is for now very difficult to track every student that changes school from the 9th to the 10th grade. The solution is assessing secondary schools that have the basic cycle as well. These schools will have a fairly big percentage of students finishing the 9th grade and applying for the 10th grade in the same school.

The second and third input variables are related to the socio-economic context of the school. The second input variable, “Parent’s average number of years in school”, intends to reflect on the background of the pupils (family background). This data is gathered through annual questionnaires provided by the BESP website. Schools usually gather this type of data in the beginning of each school year surveying every student. It is known how important family background is in determining the student’s aspiration, motivation towards education. The assumption here is that family background is core in determining the student’s achievements in school. For example a white-collar mother and father will most likely foster their children to pursue a higher education degree.

The third and last input variable, “Ratio of students not subsidized by the state”, is related to the economic environment of the school. This is the ratio between the number of students not subsidized by the state and the total number of school students. This variable is important to reflect differences between schools located in wealthy areas and schools in a deprived economic context. The reason is obvious. A school in a deprived economic area will most likely have a bigger number of students applying for subsidies than a school located in a wealthy area (Portela et al, 2007). If on one hand family background is important in determining the students’ achievements, on the other hand the family economic situation plays a big role as well. This data is gathered as well with school annual questionnaires available on the BESP website. This variable is the opposite of the Context indicator “Ratio of economic deprivation” because this way, it is expected that improving the inputs is expected to improve the outputs, making this an isotonic variable (Portela et al, 2007).

To perfectly assess school performance it is compulsory that the input and output variables are regarding the same group of students. However, it is not possible to cope with the large number of students changing schools from the 9th to the 10th grade and even during the secondary level (10th, 11th and 12th grades). The proportion may change from school to school but the DEA will be performed using input data from 3 school years before the current year and output data for the current year. This solution does not guarantee the same group of students, but tries to maximize the number of students that the school really had and impact in. (e.g. input student related variable data from the year 2005/2006 – 9th grade, while other data is regarding the school year of 2008/2009 – 12th grade).

4.3.1.2 Outputs

The output variables reflect students achievements at the end of Secondary Education (12th grade) and are measured with the variables in [Table 2](#).

The first variable “Average scores on exit on national exams (secondary cycle)” directly reflects how well the students performed in a fair measurement system (the national exams). As said earlier, the requirements for these exams are only the ones done by students following the general programmes (60,61,62,63,64) because typically these programmes embrace the students to whom the grades are important to pursue higher education. There are many other programmes, among the professional programmes, but these students do not commonly take the national exams (except for a very small percentage of students wishing to pursue higher education).

The second variable “Percentage of students entering public higher education” reflects the percentage of students that entered public higher education institutions (universities or polytechnic institutes). This percentage is calculated in relation to the number of students registered in the 12th and final year of the secondary cycle at the beginning of the academic year. This data is gathered through the annual questionnaires.¹

The third variable “Percentage of students that completed secondary education in 3 years” reflects the importance of maintaining an exemplary academic path meaning that students should take 3 years to finish a cycle that is suppose to last 3 years.

The fourth variable “Percentage of students that did not abandon secondary education” reflects the dropping-out trend (or the lack of it) in the 3 years of secondary education (10th, 11th and 12th). The definition of this variable is similar to the input “Ratio of students not subsidized by the state”. It is written in the negative form to make this an isotonic variable.

The fifth and last variable “Percentage of students enrolled in the national exams” is meant to reflect the ratio between the students that applied for the national exams of the courses that they were taking and the total number of students that should be applying to the national exams according to the courses they were enrolled.

Since the first publication of schools rankings an opportunistic mind-set in school boards was developed. The idea is to instruct the worst performing students during the course of the school year to cancel the automatic enrolment in the exams. Rankings usually only regard students registered in the school (“internal students”) because to taking into account external proposed students (students that are not registered in the school but want to take the exams) do not translate the impact that the school has on the students. Obviously an external student is no good assessment of how well the school is performing. Since there is no explicit distinction between external students and students cancelling the enrolment, so the school trying to apply this method will appear in a higher position in the rankings.

¹ Both “Percentage of students employed after 6 months after finishing the Professional programme” (described in the professional chapter) and “Percentage of students entering public higher education” have proved to be very hard to gather data by the schools. However, in the spirit of the project these variables are purposely kept in both models to keep reminding schools of how important it is to do follow-ups on their students after they completed the correspondent cycles: professional and Scientific-Humanistic programme.

With this variable it is possible to appeal to ethics on the behalf of school boards because improving the average results on the national exams will not make the school score higher performance if that is done at the expenses of lowering the percentage of students enrolled in the national exams.

4.3.2 Model Implemented for illustration purpose

Many of the input and output variables in the DEA model are dependant of the schools acceptance of the BESP platform and collaboration by answering the questionnaires. The only two variables that are not dependant of schools “input” are the average scores on entry and the average scores on exit (9th grade national exams and 12th grade national exams respectively). Every other variable (the socio-economic related inputs and the other 4 outputs)² require that the user actively helps improving the dataset and therefore a more complete Data Envelopment Analysis.

In the current state of the BESP project there aren’t nearly enough schools answering the questionnaires so it almost useless to try the DEA model with the variables defined in [Table 2](#) – the inclusion of school dependant variables does no difference in the efficiency scores.

The current best fit input and output variables for performing a limited assessment of school performance is seen in [Table 3](#).

² see [Table 2](#)

Inputs	Outputs
Average scores on 9 th grade Portuguese national exam	Average scores on 12 th grade Portuguese national exam
Average scores on 9 th grade Math national exam	Average scores on 12 th grade Math exam
	Average scores on 12 th grade Biology & Geology national exam
	Average scores on 12 th grade Physics & Chemistry national exam
	Average scores on 12 th grade History national exam
	Average scores on 12 th grade Math Applied to Social Sciences national exam
	Average scores on 12 th grade Economy national exam
	Average scores on 12 th grade Geography national exam

Table 3 – Input and Output variables for a limited schools performance assessment

This model contains the average results on entry for the two national 9th grade exams and the top 8 exams with a bigger number of students enrolling in the last 3 school years. This model does not in any way exclude the possibility of easily adding other variables (that is done in the DEA page by selecting the inputs and outputs) but given the current school adherence it already provides conclusive analysis on school performance.

The data set for the entire universe of Portuguese secondary schools (around to 600) had to be reduced to schools having the third cycle and therefore 9th grade national exams. For the 9th grade both exams (Portuguese and Math) are compulsory, so every school in this data set has the two national exams, but for the average scores on exit some schools do not have every one of the 8 exams being taken.

To deal with these missing values the solution is to replace the output missing values with zero according to Kuosmanen (2002).

4.4 Implementation

The implementation of the DEA model was coded entirely in this project. An effort like this has no precedents in the context of this project. It required investigating the existing standalone DEA

software and then design a unique coding of the mathematical model. The DEA model, explained in the previous section, is a set of linear programming problems. Linear programming is a technique for optimization of a linear objective function, subject to linear equality and linear inequality constraints. It determines the way to achieve the best outcome (such as maximum profit or lowest cost) in a given mathematical model and given some list of requirements represented as linear equations.

For the DEA model there is one linear programming problem for each school, in which the objective function (β_0) represents the inverse of the school efficiency score and the variables values can be used to give the school's output targets (this is an output oriented model).

The DEA model was implemented in the BESP platform using a linear programming solver from the COIN-OR initiative.

COIN-OR (**C**omputational **I**nfrastructure for **O**perations **R**esearch) has a project called OS (Optimization Services) provides source code for libraries and executable programs that implement OS standards. The objective of Optimization Services is to provide a set of standards for representing optimization instances, results and solver options.

Among the possibilities of the OS project it provides a command line executable: *OSSolverService*. The *OSSolverService* is a command line executable designed to pass problem instances in either OSiL, AMPL nl, or MPS format (in the BESP project MPS is used) to solvers and get the optimization result back to be displayed either to standard output or a specified browser.

The MPS stands for Mathematical Programming System and is a file format for presenting and archiving linear programming and mixed integer programming problems. This is a fixed column file format with the biggest limitation being the fact that it is not possible to specify the direction of optimization. The default direction is minimization. (An example of an MPS file can be seen in [appendix B](#))

The solver used is CLP (**C**oin-or **L**inear **P**rogramming), an open-source linear programming solver written in C++ which is the default solver in the *OSSolverService* executable.

The BESP DEA page (explained in detail in [chapter 4.1](#)) was designed to automatically create the problem instances for each school for a given year. With one page click the administrator can create the MPS files for the given year and the inputs and outputs previously chosen (close to 450 files created or updated if the file exists already in the server). The default options are the inputs and outputs detailed in [chapter 5.2](#) but the system allows the choosing of other variables.

After successfully creating the problems instances files (one for each school and year) another step is required for the solving of the problem instances. The *OSSolverService* executable (hosted in the server) is then called outputting the optimization results for each problem instance.

```
OSSolverService -mps <fileName.mps> > <outputFile.txt>
```

This is the call performed for each school for a given year. If the year selected is for instance 2007 then the problem instance files will be named “dea2007<school number>.mps” and the output files will be named “dea2007<school number>.txt” (See and example in [appendix C](#)).

The output files will also be hosted in the server and contain the objective function results, the variable values and their reduced costs.

The system parses each file to get the efficiency score and each of the school’s output targets (both saved in the BESP database).

4.5 Analysis of the Results

Using the model explained in the previous chapters it is possible to obtain the performance scores for each school - as seen in [appendix D](#) (these are scores for the school year of 2007/2008).

Taking the school year of 2007/2008 it is possible to see that there are 104 schools considered efficient according to the DEA in a universe of 431 schools. The rest of the schools also present very high efficiency scores, being the average efficiency score 93.84%.

This very high average of efficiency scores can be explained by the fact that the efficiency scores are relative and therefore, this high average efficiency in the DEA results can be interpreted as a sign of homogeneity between schools efficiency. (E.g. if all schools produced the same outputs with the same inputs they would all be considered efficient). Though this is a very big sample analyzed it is possible to assess that there are similarities between schools in the given input variables and output variables, therefore these high efficient score do not directly translate to Portuguese Secondary Schools being very efficient.

There is a big difference in the old ranking systems based on average scores and the DEA results. When comparing the ranking positions of each school the average difference is 102 places and the maximum difference reaching 420 places – a school that in traditional rankings systems would stand near the bottom of the list and in DEA is considered an efficient school.

Lets analyze an school considered inefficient for the year of 2008: Escola EB 2,3/S de Michel Giacometti from the district of Setúbal. This school ranked at number 305 (out of 431) with an efficiency score of 91.34%. In the traditional ranking systems based on weighted average results of the 12th grade national exams this school ranked at number 239 with an average result of the 12th grade national exams of 10.52. This big difference of 66 places between these two types of performance assessment begins to give an idea of the lack of accuracy in the assessment of this school’s performance, when uncontextualised rankings are used.

School Michel Giacometti					
	Observed	Target	Sc. 67	Sc. 181	Sc. 405

			$\lambda = 0.16$	$\lambda = 0.42$	$\lambda = 0.25$
Portuguese 9 th grade	3.18	3.18	3.09	2.68	3.45
Math 9 th Grade	2.51	2.51	2.10	1.91	3.45
Portuguese 12 th grade	10.2	11.17	11.49	9.88	12.92
Math 12 th grade	13.32	14.77	15.25	13.31	16.31
Biology & Geology	11.04	12.08	10.08	11.61	14.72
Physics & Chemistry	9	10.67	8.21	10.61	12.73
History	10.55	11.00	12.61	10.33	10.55
Economy	9.142	10.00	9.84	8.18	9.79
Applied Math	–	–	9.68	–	14.22
Geography	10.77	11.80	12.05	11.42	12.85

Table 4 - DEA results for an example school

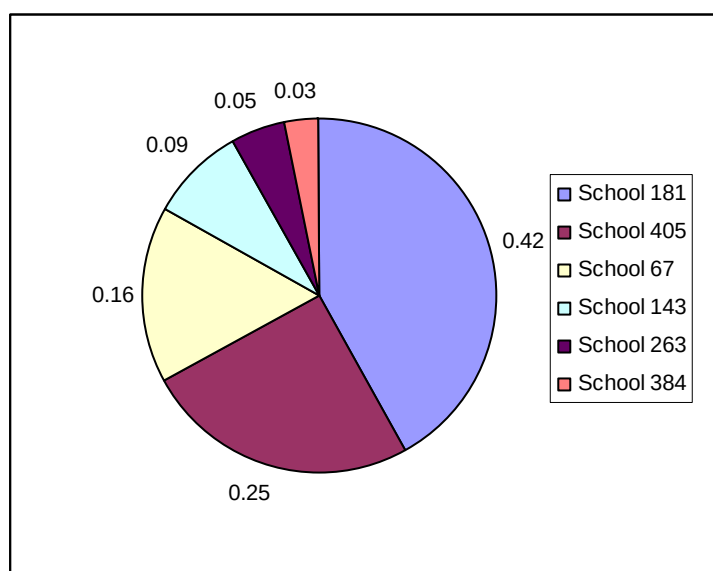


Figure 23 - Coefficients of the benchmarks for target setting

This school's benchmarks are schools 67, 143, 181, 263, 384 and 405 as can be seen the above table. The coefficients are the DEA values for the variables $\lambda_{67}, \lambda_{143}, \lambda_{181}, \lambda_{263}, \lambda_{384}, \lambda_{405}$ (see Model Specification [chapter 5.3](#)). Figure 23 details the weight distribution of each one of the benchmarks for this inefficient school.

Being an output oriented model means that this particular school to be considered efficient without changing the input values (9th grade Portuguese and Math) need to achieve the targets for each output seen in Table 4 and Figure 24.

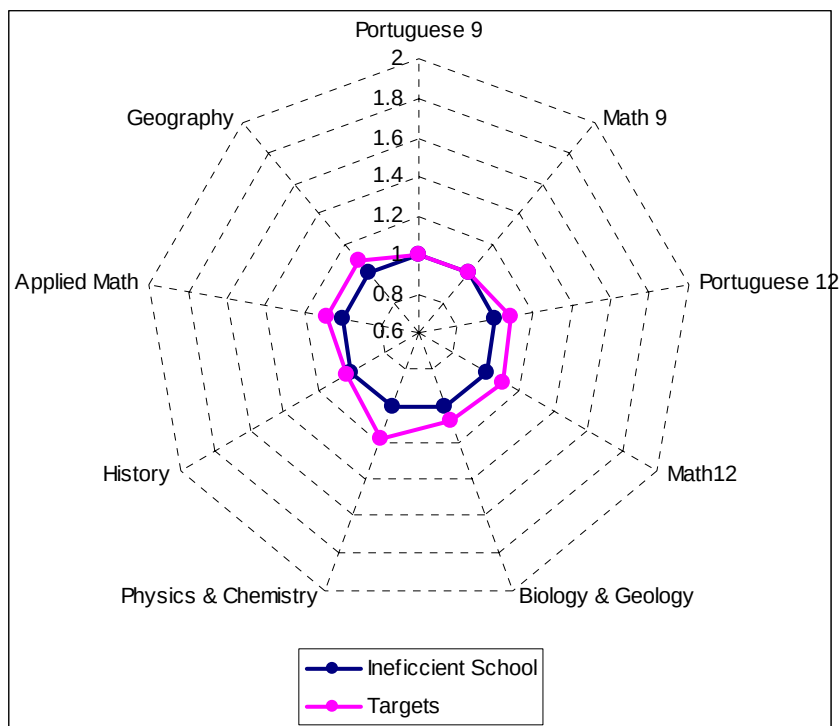
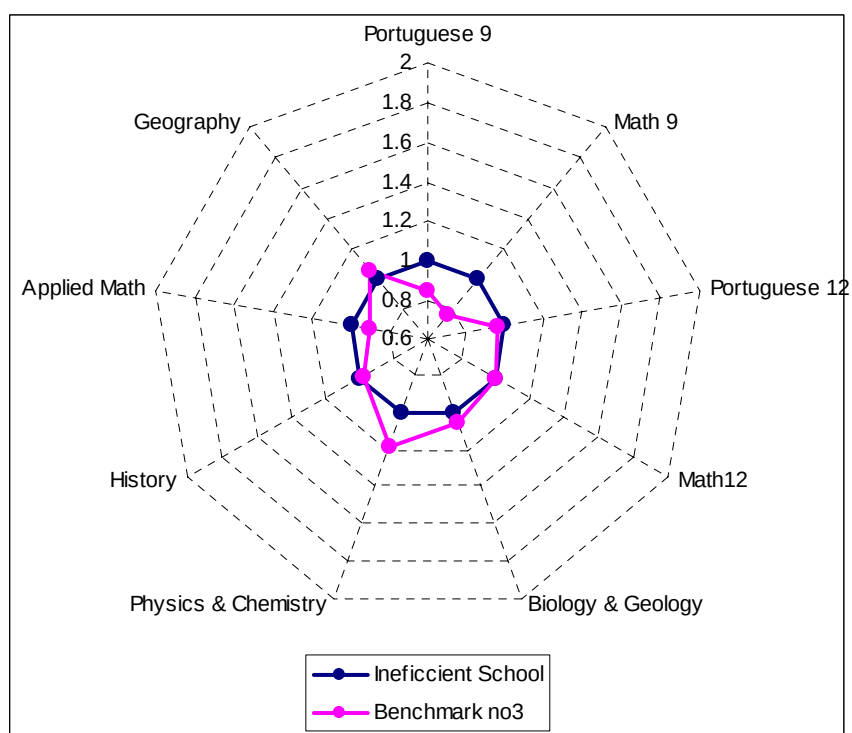
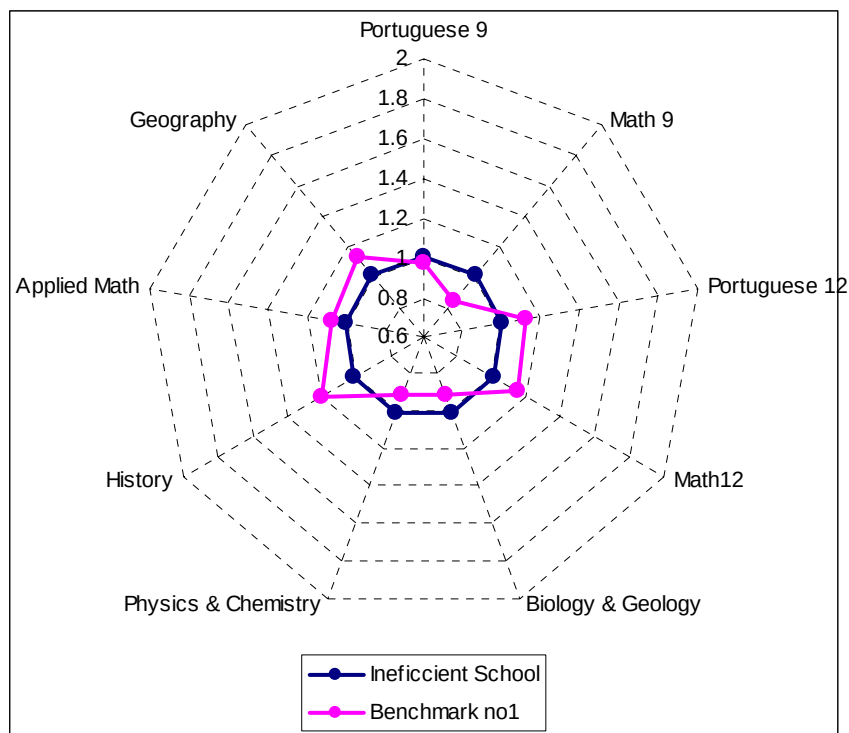


Figure 24 – Inefficient School and its targets

4.5.1 Graphical Analysis

Available to the schools are radar graphs that compare the school with their benchmarks. This graphical analysis is still under development and is expected to be completed soon.

Figure 21 compares the school with their 6 benchmarks in the two inputs and the 8 outputs. These values are normalized for the inefficient school values, making the comparison easier. In the same way these example graphics are produced, different graphics can be produced according the input and output variables chosen.



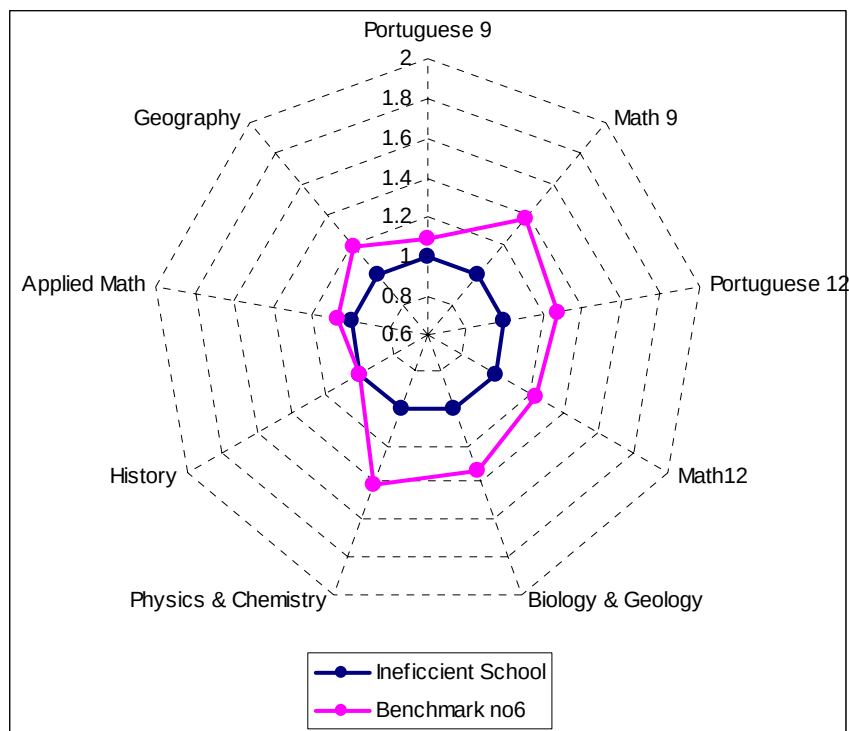


Figure 25 – Comparison of the inefficient school with 3 of its benchmarks

These two efficient schools were selected because they are the ones that contribute with more than 10% for the target construction.

These radar graphs are produced for each school for each year and are only accessible to the particular school.

4.6 Conclusions

Implementing this DEA model integrated into the BESP benchmarking platform proved to be a step towards improving the overall school performance assessment available in the platform.

A number of meetings with school boards to discuss the platform resulted in a strong support and desire to see implemented a functionality that was already one of the goals of this master project: producing a global performance measure obtained with Data Envelopment Analysis.

This method is performed automatically in the BESP server and the results are displayed for each school and a DEA score ranking is made available for the schools (because the data used may not be of public domain). If there is permission from the schools then the scores can be made public.

Keeping in mind that the school boards members are not expected to be proficient in the DEA methodology, a graphical view of the results for the schools targets (in the case of inefficient school) allowed an easier analysis.

5 Conclusions and Future Work

5.1 Conclusions and Goals Fulfillment

Of the starting set of goals for this project some were relegated due to priorities changing through the course of the project. This was accomplished with a set of constant meetings with the project's supervisors to discuss what needed more focus according to the evolution of this master project and the state of acceptance and usage of the BESP platform.

All of this project's goals were accomplished during the course of these 20 weeks.

The existing BESP platform lacked robustness, documentation and end-user feedback. In this project the platform was tested and the results were validated. This project provided the consistency and validity the platform needed to be considered ready for the launching phase.

This report constitutes a full documentation of the BESP platform which is core in future maintenance of the website and it makes it easier to implement future functionalities. The website is now more user-focused with an online help functionality.

It was in the scope of this project to validate the results produced by the system and that was totally accomplished. Beyond validating the results, in some cases formulas had to be corrected and the graphical display of the results refined and the now is now ready for mainstream usage.

This project implied visiting schools to get feedback and that proved to be very important and lead to development suggestions that would not come up any other way. Meeting the end-user of the platform allows a level of understanding of the usage of the site that is not possible without serious input from different real end-users. Developing the site user-centered and at the same time meeting different end-users from different geographical and socio-economic contexts results in a website that is highly focused on the schools and their users and has now proven to be very well accepted.

It was implemented a global performance measurement aggregating several indicators calculated through Data Envelopment Analysis. For that matter it had to be studies which variables were the most suitable for the model and entirely code the complete mathematical model of DEA to be fully available online in the BESP page. Fulfilling this goal in this particular way (Implementing the entire DEA model and integrating this functionality in a Benchmarking webpage) is unprecedented in the Education Performance assessment sector.

It was as well in the scope of this project to maintain the platform and to develop improvements and that as well been achieved. There were several improvements and corrections made to the platform to make it ready for publication but since the platform is still in the testing, besides the early results from the visited school it is still soon to say the level of impact the BESP might have.

Including in the DEA model user preferences for weights is to be made in future work. Due to the fact that the workload to produce the problem instances and solve those problem instances is very large this option is for now restricted and therefore users may not yet produce themselves different DEA models and scores rankings. However, user preferences for different models are already functioning allowing the user to choose different input and output variables.

All the project goals have been met which resulted in a very successful Master project and a consistent and robust BESP platform with already manifesting good results.

5.2 Future work

At the end of this Master project there were some possibilities for future improvements in the BESP platform. A summary of those improvements is described here.

To grant a school access to the BESP platform it is now given a password for each school upon meeting with school boards, but it is not feasible to perform that action for the entire universe of Secondary schools in Portugal. Using a login and password pair equal to the Ministry website like GEPE would solve this situation for distributing the access codes.

Creating the MPS instance files and then using the solver to get the DEA results takes a couple of minutes because this process is very server consuming. Reducing the time that takes to create and solve these instances could allow the possibility of the DEA model to be user-defined, i.e. the user could be allowed to produce different DEA models, making this process user-defined.

The data volume managed by this platform is very big and this DEA process along with the process of annually creating the questionnaires, mapping the data from the ENES and ENEB databases and calculating the benchmarking results are very time-consuming (the first process around 30 minutes and the second around 2 hours), so it is very important to find a way to reduce this time given that the server has its own limitations.

5.2.1 Including in the DEA model user preferences for model weights

This will allow the possibility of having different rankings lists accordingly to the importance associated with the factors.

5.2.2 Tracking Students

In the DEA model the student related inputs are considered for the school year of 3 years before the school year of the exercise. With this measure it is possible to say the student related variables broadly concern the same group of students (Percentages may vary tough).

There is not a clear notion of what percentage of students (from the original group of students taking the 9th grade national exams) remains in the same school and actually end up taking the 12th grade national exams.

To produce a more accurate exercise would require a system to track down the entry students' previous academic path. It would be possible to know the 9th grade national exams results for each student at the entrance of the 10th grade other than estimate that score by taking the average national exams scores for that school 9th grade.

5.2.3 MISI

Created in 2007 by the Education Ministry MISI (Gabinete Coordenador do Sistema de Informação do Ministério da Educação) headed by Prof. Doutor Luís Custódio developed a platform in which all schools and teaching establishments under the Education Ministry (Primary, Basic and Secondary).

In this platform is gathered data that is of compulsory for the schools to send regarding the social-economic context of the students, their results, school budgets and resources among other variables.

The BESP platform is currently asking in the questionnaires a big number of questions that schools already submitted the answers to the MISI platform. This fact raises a problem: schools are reluctant to submit the same data twice, which requires some effort to organize the internal data and then submit what is asked.

A major improvement on the BESP website could be the access to the MISI platform data. Accessing the MISI database would:

- Reduce the number of question asked in the annual questionnaires and therefore the expected effort from the schools on inputting the data.
- Reduce the margin of erroneous input data and increase the overall reliability of the platform

This access is not done for now because MISI databases are not of public domain, to access their data would require the authorization from MISI responsible parties and that has not been accomplished.

One of the reasons MISI may be reluctant to grant access to this data is that their data is student oriented which would be always private domain (schools are not allowed to grant that that of information to any party but the Ministry). However in the BESP platform it is not about the students as it is about the school so the data that would best fit the platform is the per-school totals – and therefore not discerning student information. (E.g. total number of subsidized students, total number of school students).

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Appendix A: IO 2009 – 14th APDIO Congress

During the course of this Project arose the opportunity to write a paper for the 14th congress of the Associação Portuguesa de Investigação Operacional.

The purpose of this paper was to explain why the BESP platform was created, its goals and mission, and a summary of key functionalities that distinguish this platform from any other in Portugal.

The BESP platform will be presented in September in the APDIO congress, in Lisbon.

BESP – Benchmarking de escolas secundárias Portuguesas

M. C. A. S. Portela [†] A. S. Camanho [‡] M. Fernandes [§] D. Borges ^{†‡}

[†] Universidade Católica Portuguesa, Porto
csilva@porto.ucp.pt

[‡] Faculdade de Engenharia da Universidade do Porto
acamanho@fe.up.pt
ei04016@fe.up.pt

[§] INEGI, Instituto de Engenharia Mecânica e Gestão Industrial
miguel.fernandes@inegi.up.pt

Abstract

The BESP (Benchmarking Portuguese Secondary Schools) Website has been created within a research project financed by FCT (Portuguese Foundation for Science and Technology) and developed in cooperation between the Portuguese Catholic University in Porto, the IDMEC from the Faculty of Engineering of the University of Porto, and by INEGI. BESP is a benchmarking platform for secondary schools whose aim is to help schools in their self and external evaluation. For that purpose, a set of key performance indicators were developed in relation to which schools can, in real time, analyze their performance relative to other schools and analyze the evolution of their performance over time. To the general public two main tools are available: one that allows the comparison of a school with others in a given indicator, and another that allows the construction of league tables of schools based on criteria defined by the user. The indicators made available at this level are built using public data concerning the results of students in national exams at the end of secondary education. Schools can also have access to an enlarged set of indicators, as long as they have registered in the website and have filled in a questionnaire to provide BESP with data that is not public.

Resumo

O website BESP (Benchmarking de Escolas Secundárias Portuguesas) foi criado no âmbito de um projecto de investigação financiado pela FCT, e desenvolvido em cooperação pela Universidade Católica do Porto, pelo IDMEC - pólo FEUP e pelo INEGI. O BESP é uma plataforma de benchmarking de escolas secundárias Portuguesas cujos objectivos são servir de auxílio à avaliação interna e externa das escolas. Para isso, foram desenvolvidos indicadores de desempenho relativamente aos quais as escolas podem, em tempo real, analisar o seu desempenho em termos comparativos com outras escolas, e analisar a evolução observada em cada indicador ao longo do tempo – e portanto ter uma ideia do sentido da evolução do seu desempenho. Disponibiliza-se ao público em geral a possibilidade de comparar uma determinada escola com outras com base em indicadores construídos utilizando dados de domínio público, nomeadamente os dados provenientes de resultados dos alunos em exames nacionais. Também é possível elaborar listas ordenadas de escolas ('rankings') com base em critérios parametrizáveis pelo utilizador. As escolas podem ter acesso a um conjunto mais alargado de indicadores, o que requer um registo prévio na plataforma e o preenchimento de um questionário on-line para fornecer dados de domínio não público.

Keywords: benchmarking, school evaluation, performance indicators

Title: Benchmarking Portuguese Secondary Schools

1 Introdução

Nos últimos anos as preocupações políticas e sociais relativas à qualidade da educação e à avaliação de escolas têm aumentado tanto a nível nacional como

internacional. Estas preocupações, que também servem como um meio de garantia de qualidade, traduziram-se em legislação nova (e.g. Despacho 484/2006 sobre sistemas de avaliação integrados do ensino superior, e Lei 31/2002 que legisla a avaliação da educação básica e secundária) e na criação de comités nacionais e internacionais para definir os factores de melhoria dos sistemas educativos e os factores de qualidade das escolas (e.g. ‘working committee on quality indicators’ da União Europeia, ou Projecto ESSE - Effective School Self-Evaluation).

O procedimento actual de avaliação externa promovido pelo Ministério da educação consiste em visitas feitas anualmente por equipas de avaliação do IGE (Inspeção Geral da Educação) a um conjunto de escolas seleccionadas. Dessas visitas resulta um relatório onde as escolas são avaliadas (numa escala de Muito Bom, Bom, Suficiente ou Insuficiente) em vários domínios: (Resultados; Prestação do Serviço Educativo; Organização e Gestão Escolar; Liderança; Capacidade de Auto-Regulação e Melhoria). Para além disso, as escolas devem ter programas de avaliação interna ou de auto-avaliação cujo carácter se tornou obrigatório com a Lei 31/2002 (20 Dezembro). Apesar do carácter obrigatório da avaliação interna, cada escola segue modelos de avaliação distintos, e em muitas escolas este tipo de avaliação não é efectivamente levada a cabo de forma sistemática.

Ao mesmo tempo que as escolas se debatem com a obrigatoriedade de procedimentos avaliativos, anualmente os jornais publicam rankings onde as escolas são seriadas de acordo com os resultados obtidos pelos seus alunos nos exames nacionais. Estes rankings têm sido sujeitos a duras críticas por apresentarem seriações de escolas descontextualizadas (ou seja, sem considerarem os resultados dos alunos à entrada do ciclo educacional, ou o seu contexto sócio-cultural, entre outros aspectos). Apesar das críticas (ver e.g. Matos et al., 2006), os rankings reflectem um importante passo na responsabilização social das escolas e são sem dúvida úteis aos encarregados de educação que desta forma têm informação comparativa entre escolas, ainda que esta nem sempre seja justa, particularmente para escolas em ambientes sociais mais desfavorecidos.

O BESP é uma plataforma Web destinada ao ensino secundário que permite às escolas acederem a informação relativa a um conjunto de indicadores que podem servir de base a uma avaliação interna da escola. Desta forma, a avaliação poderá passar de esporádica e diversificada para regular e standardizada. Os indicadores contemplados no BESP dizem respeito não só a resultados dos alunos, mas também ao contexto, recursos, e processos da escola, o que vai de encontro ao modelo CIPP (Context, Input, Process and Product evaluation) de Stufflebeam, 2003.

Os indicadores disponíveis no BESP poderão servir não só de apoio à auto-avaliação das escolas, como também servir como ferramentas de avaliação externa ou de benchmarking. O benchmarking tem como objectivo servir de apoio ao estabelecimento de objectivos e metas a alcançar, tendo por base uma comparação com as organizações com melhor desempenho da indústria ou sector (ver e.g. Camp, 1989). No BESP o benchmarking é feito para cada indicador através de uma identificação do percentil em que cada escola se encontra, permitindo à escola saber que percentagem de escolas apresenta valores inferiores ou superiores ao seu num dado indicador (ver também, Costa et al., 2007).

A utilização de plataformas Web para benchmarking é uma realidade emergente, embora já exista alguma história deste tipo de plataformas quer no contexto educacional (e.g. no Reino Unido existe o Financial Benchmarking website for schools) quer noutros contextos (e.g. icbench – usado no benchmarking de empresas Portuguesas de construção civil, ou o iDEAs - <http://www2.isye.gatech.edu/ideas/> - usado para benchmarking e avaliação do desempenho de armazéns nos Estados Unidos).

O objectivo deste artigo é apresentar a plataforma BESP descrevendo as ferramentas disponíveis e as suas potencialidades e utilidade para as escolas e público em geral.

2 Indicadores

Os Indicadores de desempenho das escolas são uma ferramenta central na plataforma BESP. O conjunto de indicadores foi definido apenas para os cursos científico-humanísticos e para os cursos profissionais do ensino secundário, pois os restantes cursos têm dimensão residual no conjunto das escolas nacionais (ver OTES/GEPE, 2008). Para a construção dos indicadores usaram-se duas fontes de dados: dados públicos dos resultados dos exames nacionais, disponibilizados pelo Ministério da Educação através das bases de dados ENES (Exames Nacionais do Ensino Secundário) e ENEB (Exames Nacionais do Ensino Básico), e dados fornecidos pelos responsáveis das escolas através do preenchimento de inquéritos anuais na plataforma BESP.

Adoptando o modelo CIPP de Stufflebeam (2003), os indicadores foram classificados em 4 grandes áreas:

- Indicadores de resultados:

Os indicadores de resultados são calculados com base no aproveitamento obtido pelos alunos da escola. Parte dessa informação é disponibilizada pelo Ministério da Educação e outra parte é obtida através dos inquéritos preenchidos pelas escolas. Assim, alguns indicadores são acessíveis ao público em geral e outros são visíveis apenas por escolas registadas. Estes indicadores são diferentes conforme se considerem alunos dos cursos científico-humanísticos ou alunos dos cursos profissionais. Como estes últimos não são submetidos a exames nacionais, o leque de indicadores de resultados neste caso é mais reduzido.

- Indicadores de recursos da escola:

Dizem respeito aos recursos da escola ao nível de professores, materiais, custos e receitas. São calculados com base nas respostas aos inquéritos fornecidas pelas escolas, logo são indicadores cujos gráficos só podem ser visualizados por escolas registadas.

- Indicadores de contexto:

Estes indicadores dizem respeito à envolvente social e económica da escola. São calculados tendo por base a informação obtida através dos inquéritos às escolas e do Instituto Nacional de Estatística. O indicador que diz respeito a informação do INE é acessível ao público enquanto os outros são visíveis apenas por escolas registadas.

- Indicadores de processo;

Os indicadores de processo relacionam-se com práticas e processos da escola. Os dados utilizados no cálculo destes indicadores são obtidos através dos inquéritos e por esse motivo só são visíveis para escolas registadas.

No conjunto destas 4 áreas existem 94 indicadores destinados às escolas secundárias portuguesas, para os cursos científico-humanísticos e profissionais.

3 Plataforma

A plataforma BESP organiza a informação relativa ao desempenho das escolas portuguesas. Permite a recolha de dados públicos sobre os resultados dos exames nacionais, bem como a recolha de dados específicos de cada escola, através do preenchimento de inquéritos on-line. Desta forma, a plataforma contém um repositório de dados, que permite efectuar análises comparativas do desempenho das escolas com base num conjunto de indicadores (i.e., benchmarking), bem como caracterizar a evolução do desempenho de cada escola ao longo do tempo. Também permite a visualização de rankings dos resultados das escolas, baseados na informação existente nas bases de dados de exames nacionais do ensino secundário (ENES). A estrutura geral do BESP está representada graficamente na sua página de entrada, tal como se ilustra na Figura 1.

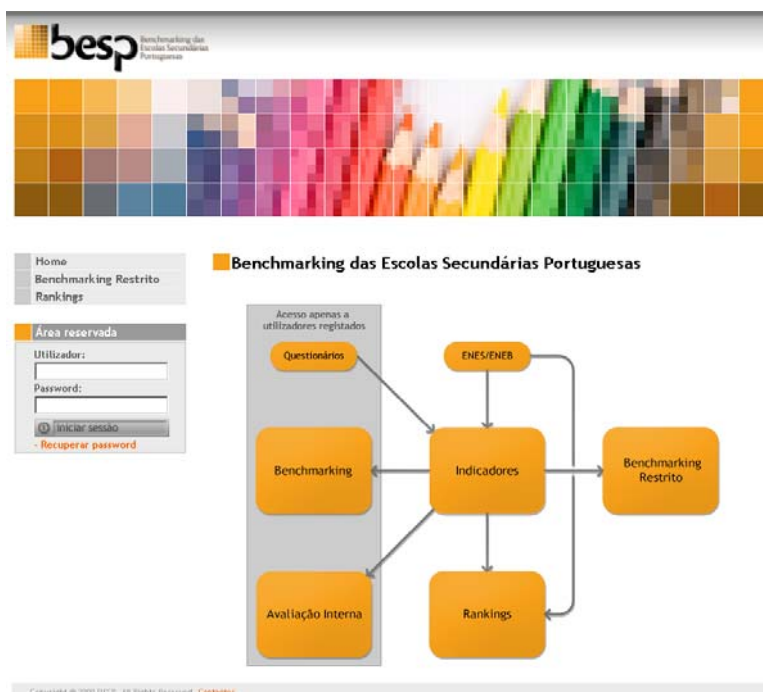


Figura 1 - Página de entrada do BESP

A plataforma web BESP possui duas áreas com funcionalidades distintas:

- Área Pública, com as seguintes funcionalidades:
 - Home
 - Benchmarking restrito
 - Rankings
- Área Reservada, com as seguintes funcionalidades:
 - Editar dados da escola
 - Avaliação interna
 - Benchmarking
 - Inquéritos anuais

Nos pontos seguintes descrevem-se as funcionalidades dentro de cada uma destas áreas do BESP.

3.1 Área Pública

A área pública apresenta 3 opções, que retratam as principais opções para um utilizador não registado:

- Home:

Apresenta a estrutura do site e contém uma breve descrição das funcionalidades disponíveis. A partir do diagrama com a estrutura do site é possível aceder facilmente a cada uma das áreas. Por exemplo, a partir do link “indicadores” o utilizador pode consultar a descrição e método de cálculo para os vários indicadores. O link “benchmarking” direcciona para uma descrição do processo de benchmarking.
- Benchmarking restrito:

Consiste numa amostra restrita da ferramenta de benchmarking, apenas com base em dados públicos. Esta página de benchmarking restrito apresenta valores de benchmark para qualquer escola à escolha do utilizador. O output do benchmarking para o público em geral e escolas registadas tem o mesmo formato. A diferença encontra-se no número de indicadores a que cada utilizador poderá ter acesso. O tipo de output deste processo de benchmarking será descrito na secção seguinte.
- Rankings:

Consiste numa página de rankings parametrizáveis produzidos com os dados disponibilizados pelo ENES.

A página de rankings (ver Figura 2) permite ordenar uma amostra de escolas conforme os parâmetros definidos para a comparação (proximidade geográfica, pública/privada, exame, fase, sexo e número de provas).

# Escola	Nº Provas	Média CF	Média Exame	Média CFD	Média CF	Diferença Padrão
1 Colégio Nossa Senhora do Rosário (Porto)	441	16.28	14.73	15.88	-1.55	3.7
2 Colégio São João de Brito (Lisboa)	334	14.67	14.61	14.76	-0.06	3.35
3 Colégio Moderno (Lisboa)	326	14.98	14.43	14.6	-0.15	3.28
4 Colégio Officinas de São José (Lisboa)	428	14.83	14.14	14.72	-0.69	3.51
5 Colégio de Santa Dorotéia (Lisboa)	321	14.75	14.1	14.61	-0.65	3.29
6 Colégio Luso-Francês (Porto)	314	15.83	14.05	15.35	-1.78	3.67
7 Colégio Rainha Santa Isabel (Coimbra)	302	15.99	14.05	15.19	-1.54	3.87
8 Colégio do Sagrado Coração de Maria (Lisboa)	325	15.35	13.7	14.92	-1.65	3.61
9 Escola Secundária Infanta D. Maria (Coimbra)	689	14.49	13.67	14.32	-0.82	3.75
10 Externato Ribadouro (Porto)	1121	16.31	13.6	15.99	-2.72	4.6
11 Escola Secundária do Restelo (Lisboa)	565	13.51	13.38	13.55	-0.12	3.5
12 Colégio Internato dos Cavaleiros (Porto)	302	16.17	13.25	15.38	-2.92	3.33

Figura 2 - Rankings

3.2 Área Reservada

Na área reservada as escolas registadas podem ter acesso ao processo completo de benchmarking produzido com os dados públicos e com os dados privados fornecidos pelos inquéritos.

A Figura 3 mostra o aspecto do BESP para um utilizador registado.

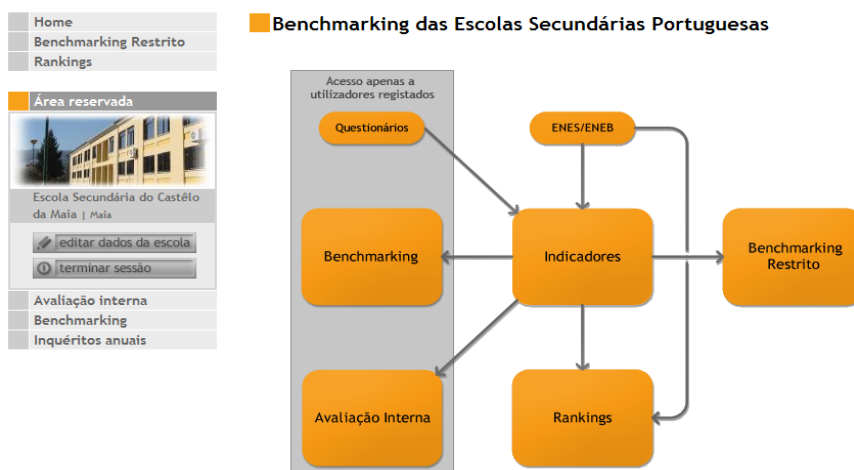


Figura 3 – Página de entrada para um utilizador registado

A área reservada apresenta 4 opções que retratam as principais funcionalidades do site:

- **Editar dados da escola:**
Permite à escola editar ou inserir dados de identificação da escola (ex. localização, contactos, imagem (avatar)) e redefinir a password.
- **Avaliação Interna:**
Permite à escola a visualização de gráficos de barras (com valores relativos e absolutos) gerados em tempo real, que permitem fazer uma avaliação da evolução do desempenho da escola (de ano para ano) nos vários indicadores. Desta forma, é as escolas podem verificar em que medida estão ou não a cumprir os seus objectivos de melhoria.
- **Benchmarking:**

Permite à escola a sua comparação em cada um dos indicadores com o universo das escolas secundárias portuguesas (ou sub-universos, como escolas do mesmo tipo ou no mesmo concelho). Neste caso os gráficos produzidos para cada indicador são gráficos de curva acumulada, que usam todos os dados públicos, e/ou todos os dados recolhidos através do inquérito on-line. Assim, a escola tem acesso ao valor de benchmark (ou medida comparativa) para cada indicador.

- Inquéritos Anuais:

Permite à escola responder aos inquéritos relativos aos dados dos indicadores privados das escolas, visualizar as respostas e verificar o estado dos inquéritos (aberto, terminado, reaberto, alterado à espera de validação)

Os tipos de gráficos produzidos na área de avaliação interna são apresentados nas Figuras 4 e 5.

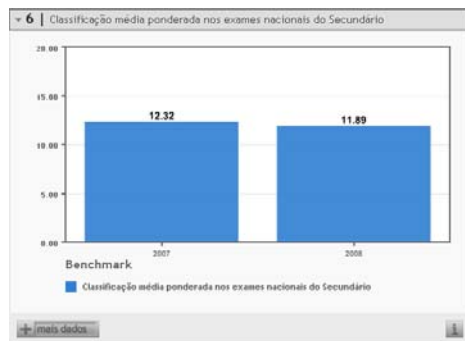


Figura 4 - Gráfico de barras absoluto

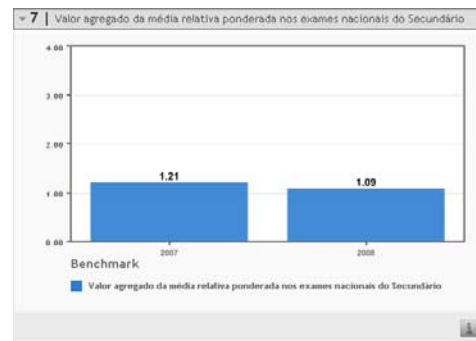


Figura 5 - Gráfico de barras relativo

A Figura 4 mostra a evolução de uma escola de 2007 para 2008 no indicador “classificação média nos exames nacionais”. Este indicador desceu de 12.32 para 11.89. É de notar que a evolução das classificações em exames estão influenciadas pelo grau de dificuldade do exame em cada ano. Assim, apresenta-se também um outro indicador: “valor agregado da média relativa ponderada nos exames nacionais do secundário” que considera uma média relativa (média da escola/média nacional) nos exames, que serve de alternativa ao indicador com a classificação média absoluta. Na Figura 5 nota-se que tendo em conta a comparação da escola com a média nacional, a escola teve uma prestação menos boa (o que não está necessariamente relacionado com a descida das classificações nos exames - exames mais difíceis podem levar a uma diminuição generalizada das classificações sem que a escola apresente uma pior prestação quando analisamos as suas classificações relativamente à média nacional).

A Figura 6 apresenta um gráfico de benchmark para uma escola em concreto no indicador “classificação média nos exames nacionais do Secundário”.

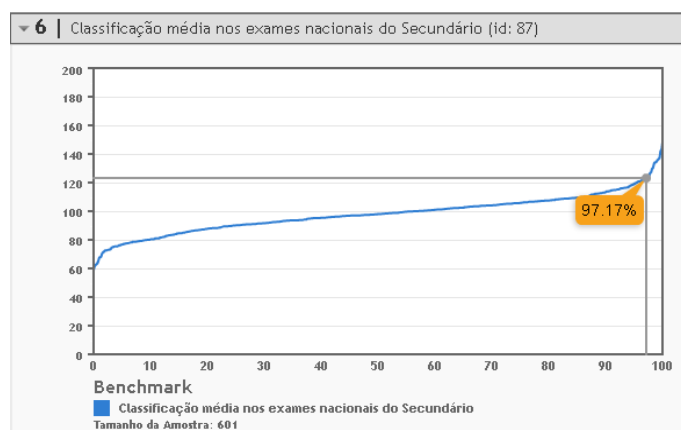


Figura 6 - Gráfico de curva acumulada

Neste tipo de gráfico, o eixo vertical representa o valor do desempenho obtido no indicador. Uma linha horizontal é traçada até à intersecção com a curva acumulada do indicador e o valor correspondente em linha vertical no eixo horizontal representa o valor de benchmark (0 a 100%). Assim, a escola representada na Figura 6 apresenta uma classificação média de 123.2 (ou 12.32 numa escala de 0 a 20) e situa-se no percentil

97.17%, o que indica que 97.17% das escolas nacionais obtiveram uma média de classificações inferior a 12.32 e 2.83% obtiveram classificações superiores. Estes gráficos são produzidos para todos os indicadores de desempenho da escola.

Neste tipo de gráfico, o eixo vertical representa o valor do desempenho obtido no indicador. Uma linha horizontal é traçada até à intersecção com a curva acumulada do indicador e o valor correspondente em linha vertical no eixo horizontal representa o valor de benchmark (0 a 100%)

Para os gráficos relativos a indicadores agregados (como é o caso do indicador da Figura 6 que agrega classificações num conjunto de exames nacionais) é apresentado complementarmente um gráfico de radar que permite uma visualização mais detalhada dos indicadores que contribuem para o gráfico de curva acumulada. Este tipo de gráfico pode ser visualizado na Figura 7.

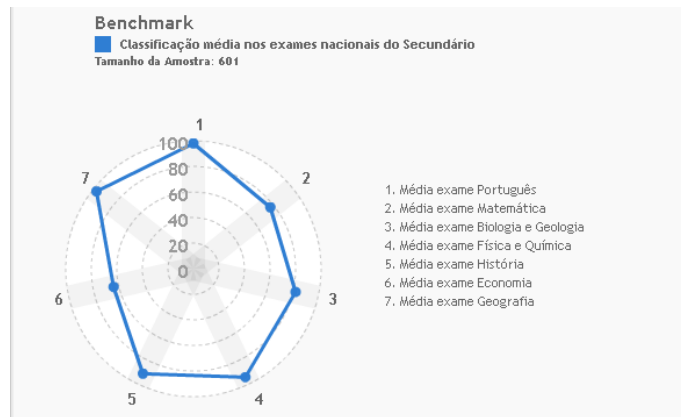


Figura 7 - Gráfico de radar

A Figura 7 permite analisar simultaneamente os percentis de cada um dos exames que contribuem para o cálculo da média agregada no gráfico da Figura 6. Para cada número no gráfico a legenda mostra a que indicador se refere. Assim, é possível concluir que a média de classificações no exame de Português está perto do percentil 95% enquanto a média das classificações do exame de Economia se encontra perto do percentil 60%.

3.3 Backoffice

Para tornar mais simples a gestão do site, existe um backoffice que permite criar ou corrigir indicadores, criar novas páginas, alterar os inquéritos anuais ou até recalculer o conjunto de indicadores para um determinado ano. Esta ferramenta de gestão possibilita um controlo efectivo do site e auxilia a manutenção do mesmo, de uma forma que reduz ao mínimo a necessidade de recorrer à programação.

4 Desenvolvimentos Futuros

O projecto BESP encontra-se numa fase de teste com um grupo de escolas que tem vindo a acompanhar o projecto desde o seu início. Nesta fase procura-se verificar a receptividade das escolas em relação aos indicadores escolhidos como KPIs (Key Performance Indicators). Procura-se obter feedback destas escolas relativamente ao BESP e, ao mesmo tempo, ir recolhendo respostas de inquéritos, de modo a que o conjunto de dados disponíveis no BESP possa ir aumentando, para benefício das escolas que terão uma base comparativa maior em alguns indicadores, e para benefício dos desenvolvimentos futuros a implementar no BESP, que requerem o conhecimento de dados não públicos.

Está em desenvolvimento a implementação de uma medida global de desempenho obtida através de Data Envelopment Analysis (DEA) que permitirá avaliar a eficiência com que uma escola utiliza um conjunto de recursos (ou inputs) na produção de um conjunto de resultados (ou outputs). Esta avaliação é sempre relativa, i.e. as escolas serão analisadas comparativamente a outras num conjunto de variáveis efectivamente observadas, e não em relação a padrões ou standards pré-definidos.

Esta técnica permite obter uma medida sumária de eficiência, definir objectivos de melhoria de desempenho para cada recurso (input) e cada resultado (output) considerado na análise e identificar “benchmarks” (i.e., escolas que são exemplos de bom desempenho).

Também será considerada uma funcionalidade que permita realizar inquéritos (online) de satisfação dirigidos aos pais, alunos e professores, nos quais estes expressem a sua opinião relativamente a alguns indicadores de satisfação com a escola.

5 Conclusão

A avaliação de escolas tem sido extensivamente aplicada em muitos países, mas em Portugal ainda é uma realidade emergente. Apesar dos esforços do Ministério da Educação em proceder, através do IGE, a avaliações externas das escolas, nem todas as escolas são contempladas anualmente nesta avaliação. Por outro lado, a avaliação do IGE não fornece em indicadores de natureza quantitativa, que podem ser úteis às escolas na percepção da sua situação actual e na definição de metas e objectivos para o futuro.

O BESP é uma ferramenta útil para as escolas na medida em que define um conjunto de indicadores, que podem ser usados de forma standard por todas as escolas na sua avaliação interna, e na medida em que permite às escolas efectuar comparações do seu desempenho em cada indicador com outras escolas. A utilização sistemática do BESP ao longo do tempo trará benefícios acrescidos às escolas na medida em que lhes permitirá ter acesso não só a dados do ano corrente mas também a dados de anos passados (o que nem sempre é fácil para as escolas, já que não existem plataformas standard de armazenamento de dados), bem como perceber a forma como a escola tem evoluído em cada indicador ao longo do tempo.

Para o público em geral o BESP contribui para que os pais e educadores se apercebam do desempenho das escolas em determinados indicadores específicos e para que possam fazer rankings à medida das suas necessidades e interesses. A implementação futura de medidas agregadas de desempenho da escola (através do DEA) será um passo importante na produção de rankings contextualizados das escolas onde se permitirá às escolas e aos encarregados de educação definirem os critérios que mais valorizam na avaliação das escolas.

6 Referências

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Appendix B: MPS file example

This is an example of what an MPS file and its translation in mathematical model view:

```

NAME          example
ROWS
  N  OBJ
  L  C1
  L  C2
  G  C3
  G  C4
  G  C5
  E  C6
COLUMNS
  X1      C1      3          C2      3
  X1      C3      12.5      C4      12.5
  X1      C5      12.5      C6      1
  X1      OBJ      0
  X2      C1      7          C2      7
  X2      C3      11        C4      11
  X2      C5      11        C6      1
  X2      OBJ      0
  X3      C1      2          C2      2
  X3      C3      12        C4      12
  X3      C5      12        C6      1
  X3      OBJ      0
  X4      C1      4          C2      4
  X4      C3      13        C4      13
  X4      C5      13        C6      1
  X4      OBJ      0
  BETA    OBJ      -1        C3      -12.5
  BETA    C4      -12.5      C5      -12.5

RHS
  RHS1    C1      3
  RHS1    C2      3
  RHS1    C3      0
  RHS1    C4      0
  RHS1    C5      0
  RHS1    C6      1

BOUNDS
  LO BND1  X1      0
  LO BND1  X2      0
  LO BND1  X3      0
  LO BND1  X4      0

```

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ENDATA

Optimize

OBJ: BETA

Subject To

C1: $3X_1 + 7X_2 + 2X_3 + 4X_4 \leq 3$

C2: $3X_1 + 7X_2 + 2X_3 + 4X_4 \leq 3$

C3: $12.5X_1 + 11X_2 + 12X_3 + 13X_4 - 12.5BETA \geq 0$

C4: $12.5X_1 + 11X_2 + 12X_3 + 13X_4 - 12.5BETA \geq 0$

C5: $12.5X_1 + 11X_2 + 12X_3 + 13X_4 - 12.5BETA \geq 0$

C6: $X_1 + X_2 + X_3 + X_4 = 1$

Bounds

$X_1 \geq 0$

$X_2 \geq 0$

$X_3 \geq 0$

$X_4 \geq 0$

End

Appendix C: OSSolverService Output

This is the OSSolver service output with the given example in appendix B. The most important fields are the objective function, the variables values, the reduced costs and the dual values of the variables

```
Input String = -mps exemplo.mps
Call Text Extra
Call scan string
call ossslex
Found option: -mps exemplo.mps
done with call to ossslex
HERE ARE THE OPTION VALUES:
MPS File Name = exemplo.mps
Coin0001I At line 1 NAME          exemplo
Coin0001I At line 2 ROWS
Coin0001I At line 10 COLUMNS
Coin0001I At line 30 RHS
Coin0001I At line 37 BOUNDS
Coin0001I At line 42 ENDATA
Coin0002I Problem exemplo has 6 rows, 5 columns and 27 elements
Do garbage collection for the nonlinear API
Parsing took (seconds): 0.001
Start Solve with a Coin Solver
SOLVER NAME = cbc
CREATING A NEW OPTIMIZATION SOLUTION
Coin0506I Presolve 2 (-4) rows, 4 (-1) columns and 8 (-19) elements
Clp0006I 0 Obj 0 Primal inf 1 (1) Dual inf 3.88 (4)
Clp0006I 3 Obj -1
Clp0000I Optimal - objective value -1
Coin0511I After Postsolve, objective -1, infeasibilities - dual 0 (0), primal 0 (0)
Clp0032I Optimal objective -1 - 3 iterations time 0.002, Presolve 0.00
DONE WITH INITIAL SOLVE
Do garbage collection for the nonlinear API
inside CoinSolver destructor
leaving CoinSolver destructor
<?xml version="1.0" encoding="UTF-8"?><?xml-stylesheet type = "text/xsl" href =
"/home/kmartin/vpath-rel/OS\stylesheets\OSrL.xslt"?><osrL
xmlns="os.optimizationservices.org"          xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance"          xsi:schemaLocation="os.optimizationservices.org
http://www.optimizationservices.org/schemas/OSrL.xsd" >
<resultHeader>
<generalStatus type="success"/>
<serviceName>Solved with Coin Solver: cbc</serviceName>
```

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```
<instanceName>exemplo</instanceName>
</resultHeader>
<resultData>
  <optimization    numberOfSolutions="1"    numberOfVariables="5"    numberOfConstraints="6"
  numberOfObjectives="1">
    <solution objectiveIdx="-1">
      <status type="optimal"/>
      <variables>
        <values>
          <var idx="0">0</var>
          <var idx="1">0</var>
          <var idx="2">0.5</var>
          <var idx="3">0.5</var>
          <var idx="4">1</var>
        </values>
        <other name="reduced costs" description="the variable reduced costs">
          <var idx="0">0</var>
          <var idx="1">0.28</var>
          <var idx="2">0</var>
          <var idx="3">0</var>
          <var idx="4">0</var>
        </other>
      </variables>
      <objectives>
        <values>
          <obj idx="-1">-1</obj>
        </values>
      </objectives>
      <constraints>
        <dualValues>
          <con idx="0">0</con>
          <con idx="1">-0.04</con>
          <con idx="2">0</con>
          <con idx="3">0</con>
          <con idx="4">0.08</con>
          <con idx="5">-0.88</con>
        </dualValues>
      </constraints>
    </solution>
  </optimization>
</resultData>
</osrl>
```

Appendix D: Efficiency Scores for 2007/2008

Rank	School	Efficiency	Rank	School	Efficiency
1	Escola Secundária de Estarreja (Aveiro)	100%	217	Escola Secundária Camilo Castelo Branco - Carnaxide (Lisboa)	95.14%
2	Escola Secundária de Oliveira do Bairro (Aveiro)	100%	218	Escola Secundária de Linda-a-Velha (Lisboa)	95.13%
3	Escola Secundária de Vagos (Aveiro)	100%	219	Escola Secundária do Fundão (Castelo Branco)	95.12%
4	Escola Secundária de Vale de Cambra (Aveiro)	100%	220	Escola Secundária de Moura (Beja)	95.09%
5	Escola Secundária de Figueira de Castelo Rodrigo (Guarda)	100%	221	Escola Secundária Dr. Joaquim Gomes Ferreira Alves (Porto)	95.07%
6	Escola Secundária de Gonçalo Anes Bandarra (Guarda)	100%	222	Escola Secundária com 3º Ciclo de Pinhal do Rei (Leiria)	94.94%
7	Escola EB 2,3/S Tenente Coronel Adão Carrapatoso (Guarda)	100%	223	Escola Secundária de Mem Martins (Lisboa)	94.91%
8	Escola Secundária D. Inês de Castro - Alcobaça (Leiria)	100%	224	Escola Secundária com 3º Ciclo Dr. Joaquim de Carvalho (Coimbra)	94.90%
9	Escola Secundária de Raúl Proença (Leiria)	100%	225	Escola Secundária de Carvalhos (Porto)	94.81%
10	Escola Secundária Frei Gonçalo de Azevedo (Lisboa)	100%	226	Colégio Rainha D. Leonor (Leiria)	94.80%
11	Escola Secundária de Pombal (Leiria)	100%	227	Escola Secundária com 3º Ciclo Dr. Jaime Magalhães Lima (Aveiro)	94.76%
12	Escola Secundária de Sacavém (Lisboa)	100%	228	Externato Delfim Ferreira - Delfinópolis (Braga)	94.74%
13	Escola Secundária Prof. Reynaldo dos Santos (Lisboa)	100%	229	Escola Secundária de Porto de Mós (Leiria)	94.70%
14	Escola Secundária de Campo Maior (Portalegre)	100%	230	Escola Secundária Gil Eanes-Lagos (Faro)	94.68%
15	Escola Secundária de Ermesinde (Porto)	100%	231	Escola Secundária Abade de Baçal (Bragança)	94.66%
16	Escola Secundária José Régio (Porto)	100%	232	Escola EB 2,3/S da Guia (Leiria)	94.45%
17	Escola Secundária de Alcanena (Santarém)	100%	233	Escola Secundária João Gonçalves Zarco (Porto)	94.40%
18	Escola Secundária de Coruche	100%	234	Escola Secundária de Mirandela	94.40%

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	(Santarém)			(Bragança)	
19	Escola Secundária Dr. Augusto César S. Ferreira (Santarém)	100%	235	Escola Secundária N.º 3 de S. João da Madeira (Aveiro)	94.34%
20	Escola Secundária de Ourém (Santarém)	100%	236	Escola Secundária Tomaz Pelayo (Porto)	94.33%
21	Escola Secundária António Inácio da Cruz (Setúbal)	100%	237	Escola EB 2,3 de Vilar Formoso (Guarda)	94.28%
22	Escola Secundária Manuel da Fonseca (Setúbal)	100%	238	Escola Secundária de Felgueiras (Porto)	94.25%
23	Escola Secundária/3 Dr. Joaquim Dias Rebelo (Viseu)	100%	239	Escola Secundária N.º 2 da Portela - Sacavém (Lisboa)	94.25%
24	Escola Secundária da Baixa da Banheira (Setúbal)	100%	240	Escola Secundária do Pinhal Novo (Setúbal)	94.22%
25	Escola Secundária da Drª Laura Ayres - Quarteira (Faro)	100%	241	Escola Secundária Mouzinho da Silveira (Portalegre)	94.19%
26	Escola Secundária de Padrão da Légua (Porto)	100%	242	Escola Secundária Dr. Manuel Fernandes (Santarém)	94.18%
27	Escola Secundária de José Gomes Ferreira (Lisboa)	100%	243	Escola EB 2,3 Fornos de Algodres (Guarda)	94.14%
28	Escola Secundária de Inês de Castro (Porto)	100%	244	Escola Secundária de Valpaços (Vila Real)	94.08%
29	Escola Secundária da Cidadela (Lisboa)	100%	245	Escola EB 2,3 José Silvestre Ribeiro (Castelo Branco)	94.02%
30	Escola Secundária com 3º Ciclo de Esmoriz (Aveiro)	100%	246	Escola Secundária de Alcains (Castelo Branco)	94.01%
31	Escola Secundária do Restelo (Lisboa)	100%	247	Colégio Liverpool (Porto)	94.01%
32	Escola Secundária Luís de Freitas Branco (Lisboa)	100%	248	Escola Secundária da Amora (Setúbal)	93.93%
33	Escola Secundária António Gedeão (Setúbal)	100%	249	Escola Secundária com 3º Ciclo de Ponte de Sôr (Portalegre)	93.90%
34	Escola Secundária de Vilela (Porto)	100%	250	Escola Secundária do Castelo da Maia (Porto)	93.87%
35	Escola EB 2,3/S Hernâni Cidade (Évora)	100%	251	Escola Secundária Viriato (Viseu)	93.84%
36	Colégio D. Diogo de Sousa (Braga)	100%	252	Colégio da Imaculada Conceição (Coimbra)	93.80%
37	Externato Nossa Senhora dos Remédios (Castelo Branco)	100%	253	Escola Secundária da Trofa (Porto)	93.76%
38	Colégio Rainha Santa Isabel (Coimbra)	100%	254	Escola Secundária de Oliveira do Hospital (Coimbra)	93.61%
39	Colégio São Teotónio (Coimbra)	100%	255	Escola Secundária de Castro Verde (Beja)	93.51%
40	Escola Internacional do Algarve (Faro)	100%	256	Escola Secundária de Tábua (Coimbra)	93.50%
41	Colégio Valsassina (Lisboa)	100%	257	Escola EB 2,3/S Monte da Ola (Viana do Castelo)	93.25%
42	Escola Técnica e Liceal Salesiana Santo António (Estoril) (Lisboa)	100%	258	Escola Secundária de Serpa (Beja)	93.24%
43	Colégio Maristas de Carcavelos (Lisboa)	100%	259	Escola EB 2,3/S Dr. Manuel Ribeiro Ferreira (Leiria)	93.24%
44	Colégio do Amor de Deus (Lisboa)	100%	260	Escola Secundária de Casquilhos (Setúbal)	93.16%
45	Externato Marista de Lisboa (Lisboa)	100%	261	Escola Secundária Manuel Cargaleiro (Setúbal)	93.13%
46	Centro de Educação Integral (Aveiro)	100%	262	Escola EB 2,3/S Vila Nova de Cerveira (Viana do Castelo)	93.03%
47	Centro de Estudos Educativos de Ançã (Coimbra)	100%	263	Escola Secundária Dr. Manuel Gomes de Almeida (Aveiro)	92.94%
48	Externato Capitão Santiago de Carvalho (Castelo Branco)	100%	264	Instituto Educativo do Juncal (Leiria)	92.94%
49	Colégio São Gonçalo (Porto)	100%	265	Escola EB 2,3/S Abel Botelho (Viseu)	92.94%
50	Colégio Cedros (Porto)	100%	266	Escola Secundária de Ponte de Lima (Viana do Castelo)	92.87%
51	Colégio Luso-Francês (Porto)	100%	267	Externato D. Duarte (Porto)	92.85%
52	Colégio Nossa Senhora do Rosário (Porto)	100%	268	Escola Salesiana de Manique (Lisboa)	92.84%

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53	Externato Ribadouro (Porto)	100%	269	Escola EB 2,3/S D. Maria II de Vila Nova da Barquinha (Santarém)	92.83%
54	Grande Colégio Universal (Porto)	100%	270	Escola Secundária D. Manuel I - Beja (Beja)	92.83%
55	Colégio dos Órfãos do Porto (Porto)	100%	271	Escola Secundária de José Loureiro Botas - Vieira de Leiria (Leiria)	92.81%
56	Externato Horizonte (Porto)	100%	272	Escola EB 2,3/S Daniel de Matos - Poiares (Coimbra)	92.80%
57	Externato D. Dinis (Antº.Carneiro) (Porto)	100%	273	Escola Secundária de Tondela (Viseu)	92.80%
58	Externato Camões (Porto)	100%	274	Escola Secundária Morgado de Mateus - Vila Real (Vila Real)	92.75%
59	Externato Paulo VI (Porto)	100%	275	Escola Secundária João de Barros (Setúbal)	92.73%
60	Externato Frei Luís de Sousa (Setúbal)	100%	276	Colégio São Miguel (Santarém)	92.71%
61	Colégio Nossa Senhora da Esperança (Porto)	100%	277	Escola Secundária Alfredo dos Reis Silveira (Setúbal)	92.64%
62	Colégio St. Peter's School (Setúbal)	100%	278	Escola Secundária Dr. João Araújo Correia (Vila Real)	92.62%
63	Instituto de Odivelas (Lisboa)	100%	279	Colégio Liceal de Santa Maria de Lamas (Aveiro)	92.58%
64	Escola EB 2,3/S de Celorico de Basto (Braga)	100%	280	Escola Secundária de S. João da Talha (Lisboa)	92.56%
65	Escola EB 2,3/S Dr. Pascoal José de Mello, Ansião (Leiria)	100%	281	Escola Secundária da Sertã (Castelo Branco)	92.52%
66	Escola EB 2,3 c/ES de Sobral de Monte Agraço (Lisboa)	100%	282	Escola Secundária de Baltar (Porto)	92.47%
67	Escola EB 2,3/S de Mestre Martins Correia (Golegã) (Santarém)	100%	283	Escola Secundária António Nobre (Porto)	92.45%
68	Escola EB 2,3/S de S. João da Pesqueira (Viseu)	100%	284	Escola Secundária de Monção (Viana do Castelo)	92.42%
69	Escola Secundária Dr. Manuel Laranjeira (Aveiro)	100%	285	Escola EB 2,3/S Octávio Duarte Ferreira (Tramagal) (Santarém)	92.37%
70	Escola Secundária João Silva Correia (Aveiro)	100%	286	Colégio de Nossa Senhora da Boavista (Vila Real)	92.33%
71	Escola Secundária Frei Heitor Pinto (Castelo Branco)	100%	287	Centro de Estudos Básico e Secundário - CEBES (Porto)	92.28%
72	Escola Secundária D. Filipa de Lencastre (Lisboa)	100%	288	Escola Secundária Fontes Pereira de Melo (Porto)	92.25%
73	Escola Secundária D. Pedro V (Lisboa)	100%	289	Escola Secundária Sebastião da Gama (Setúbal)	92.22%
74	Escola Secundária Padre António Vieira (Lisboa)	100%	290	Escola Secundária com 3º Ciclo da Sé - Guarda (Guarda)	92.20%
75	Escola Secundária Rainha D. Leonor (Lisboa)	100%	291	Escola Secundária de Alfena (Porto)	92.12%
76	Escola Secundária Alexandre Herculano (Porto)	100%	292	Escola Secundária José Estevão (Aveiro)	92.08%
77	Escola Secundária Carolina Michaelis (Porto)	100%	293	Escola Secundária de Sampaio (Setúbal)	92.05%
78	Escola Secundária Garcia de Orta (Porto)	100%	294	Escola Secundária de Peniche (Leiria)	91.92%
79	Escola Secundária Santa Maria do Olival (Santarém)	100%	295	Escola Secundária Dr. Solano de Abreu (Santarém)	91.81%
80	Escola Secundária Fernão de Magalhães (Vila Real)	100%	296	Escola Secundária Fernão Mendes Pinto (Setúbal)	91.78%
81	Escola Secundária D. Pedro I (Leiria)	100%	297	Escola Secundária D. João II (Setúbal)	91.77%
82	Escola Secundária Abel Salazar (Porto)	100%	298	Escola Secundária com 3º Ciclo do Sabugal (Guarda)	91.76%
83	Escola Secundária de Vila Verde (Braga)	100%	299	Escola Secundária de Santa Maria da Feira (Aveiro)	91.68%
84	Escola Secundária Aquilino Ribeiro (Lisboa)	100%	300	Escola Secundária de Penacova (Coimbra)	91.67%

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85	Escola Secundária Dr. João Lopes de Morais - Mortágua (Viseu)	100%	301	Escola Secundária de Vila Nova de Paiva (Viseu)	91.65%
86	Escola Secundária de Barcelinhos (Braga)	100%	302	Escola Secundária de Paredes (Porto)	91.64%
87	Escola Secundária de Camarate (Lisboa)	100%	303	Escola EB 2,3/S Engº Dionísio Augusto Cunha (Viseu)	91.61%
88	Escola Secundária de Miraflores (Lisboa)	100%	304	Colégio de Albergaria-a-Velha (Aveiro)	91.37%
89	Escola Secundária Dr. Serafim Leite (Aveiro)	100%	305	Escola EB 2,3/S de Michel Giacometti (Setúbal)	91.34%
90	Escola Secundária Tomás Cabreira - Faro (Faro)	100%	306	Escola Secundária de Frei Rosa Viterbo (Viseu)	91.27%
91	Escola Secundária Afonso Domingues (Lisboa)	100%	307	Escola Secundária Dr. Mário Sacramento (Aveiro)	91.25%
92	Escola Secundária Josefa de Óbidos (Lisboa)	100%	308	Escola Secundária de Odivelas (Lisboa)	91.23%
93	Escola Secundária Gama Barros (Lisboa)	100%	309	Escola Secundária Bocage (Setúbal)	90.95%
94	Escola Secundária Rafael Bordalo Pinheiro (Leiria)	100%	310	Instituto Educativo de Souselas - INEDS (Coimbra)	90.93%
95	Escola Secundária Aurélia de Sousa (Porto)	100%	311	Instituto de Promoção Social da Bairrada (Aveiro)	90.92%
96	Escola Secundária Jácome Ratton (Santarém)	100%	312	Escola Secundária de Marco de Canaveses (Porto)	90.89%
97	Escola Secundária Anselmo de Andrade (Setúbal)	100%	313	Escola Secundária Arquitecto Oliveira Ferreira (Porto)	90.86%
98	Escola Secundária Alfredo da Silva (Setúbal)	100%	314	Instituto Pedro Hispano (Coimbra)	90.84%
99	Escola Secundária de S. Pedro (Vila Real)	100%	315	Escola Secundária Padre António Macedo (Setúbal)	90.77%
100	Escola Secundária da Boa Nova - Leça da Palmeira (Porto)	100%	316	Escola Secundária de Penafiel (Porto)	90.65%
101	Escola Secundária José Cardoso Pires (Lisboa)	100%	317	Escola Secundária José Afonso (Setúbal)	90.59%
102	Escola Secundária Mães de Água (Falagueira) (Lisboa)	100%	318	Escola Secundária com 3º Ciclo Quinta das Palmeiras - Covilhã (Castelo Branco)	90.56%
103	Escola Secundária Padre Antº Martins Oliveira-Lagoa (Faro)	100%	319	Escola Secundária de Valongo (Porto)	90.52%
104	Escola EB 23/S de S. Sebastião de Mértola (Beja)	100%	320	Colégio D. Filipa (Lisboa)	90.32%
105	Escola Secundária com 3º Ciclo Rainha D. Amélia (Lisboa)	99.96%	321	Escola Secundária com 3º Ciclo de Sever do Vouga (Aveiro)	90.27%
106	Escola Secundária/3 Artur Gonçalves (Santarém)	99.93%	322	Escola Secundária D. Dinis (Lisboa)	90.26%
107	Externato Cooperativa da Benedita- Inst.NªSrªda Encarnação (Leiria)	99.86%	323	Escola Secundária de Vila Cova da Lixa (Porto)	90.22%
108	Escola Secundária/3 Prof. Dr. Flávio F. Pinto Resende (Viseu)	99.84%	324	Instituto D. João V (Leiria)	90.22%
109	Escola Secundária da Póvoa do Lanhoso (Braga)	99.80%	325	Escola Secundária Augusto Cabrita - Alto do Seixalinho (Setúbal)	90.20%
110	Externato D. Afonso Henriques (Viseu)	99.73%	326	Escola Secundária Emídio Garcia (Bragança)	90.14%
111	Escola Secundária com 3º Ciclo Daniel Sampaio (Setúbal)	99.71%	327	Escola Secundária Henrique Medina (Braga)	90.13%
112	Colégio Internacional de Vilamoura (Faro)	99.66%	328	Escola Secundária da Sé - Lamego (Viseu)	90.13%
113	Escola Secundária com 3º Ciclo da Batalha (Leiria)	99.66%	329	Escola Secundária de Severim de Faria (Évora)	90.07%
114	Escola Secundária Fernando Namora (Lisboa)	99.51%	330	Escola Secundária de Miranda do Douro (Bragança)	90.03%
115	Escola Secundária com 3º Ciclo de Cristina Torres (Coimbra)	99.45%	331	Colégio de Nossa Senhora da Graça (Beja)	89.99%

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116	Escola Secundária Filipa de Vilhena (Porto)	99.40%	332	Instituto de São Tiago - Cooperativa de Ensino (Castelo Branco)	89.95%
117	Escola Secundária de Almeida Garrett (Porto)	99.36%	333	Escola Secundária Poeta Al Berto (Setúbal)	89.83%
118	Escola Secundária Campos de Melo (Castelo Branco)	99.27%	334	Escola EB 2,3/S de Oliveira de Frades (Viseu)	89.73%
119	Escola Secundária Pedro Nunes (Lisboa)	99.27%	335	Colégio de Lamego (Viseu)	89.73%
120	Externato Casa Mãe (Porto)	99.13%	336	Escola Secundária Alcaides de Faria - Arcozelo (Braga)	89.61%
121	Escola EB 2,3/S de Carraceda de Ansiães (Bragança)	99.08%	337	Externato Lumen (Porto)	89.59%
122	Escola EB 2,3/S de Vila Flor (Bragança)	99.02%	338	Escola Cooperativa Vale S. Cosme (Didaxis) (Braga)	89.58%
123	Escola EB 2,3 de Mondim de Basto (Vila Real)	99.02%	339	Escola Secundária Martinho Árias - Soure (Coimbra)	89.54%
124	Externato de Vila Meã (Porto)	98.98%	340	Escola Secundária Sá da Bandeira (Santarém)	89.45%
125	Colégio Portugal (Lisboa)	98.97%	341	Escola Secundária Dr. Azevedo Neves (Lisboa)	89.43%
126	Escola EB 2,3 Miguel Torga - Sabrosa (Vila Real)	98.96%	342	Escola Secundária de S. Pedro do Sul (Viseu)	89.18%
127	Escola Secundária com 3º Ciclo da Gafanha da Nazaré (Aveiro)	98.92%	343	Escola Secundária do 3ºciclo EB Lima de Freitas (Setúbal)	89.16%
128	Colégio Miramar (Lisboa)	98.86%	344	Escola Secundária Dr. Júlio Martins (Vila Real)	89.01%
129	Escola Secundária Padre Benjamim Salgado - Joane (Braga)	98.85%	345	Escola Secundária Públia Hortênsia de Castro - Vila Viçosa (Évora)	88.87%
130	Escola Secundária Amato Lusitano (Castelo Branco)	98.83%	346	Escola EB 2,3/S de Lanheses (Viana do Castelo)	88.84%
131	Escola Secundária do Cartaxo (Santarém)	98.82%	347	Escola Secundária com 3º Ciclo de Gouveia (Guarda)	88.83%
132	Escola Secundária da Quinta do Marquês (Lisboa)	98.77%	348	Escola Secundária de Reguengos de Monsaraz (Évora)	88.62%
133	Escola Secundária do Entroncamento (Santarém)	98.76%	349	Escola EB 2,3/S de Chamusca (Santarém)	88.55%
134	Colégio São Martinho (Coimbra)	98.74%	350	Escola Secundária Ferreira Dias (Lisboa)	88.49%
135	Escola EB 2,3/S de José Relvas - Alpiarça (Santarém)	98.74%	351	Colégio de Amorim (Porto)	88.41%
136	Escola Secundária Ferreira de Castro (Aveiro)	98.66%	352	Escola Secundária de Carregal do Sal (Viseu)	88.17%
137	Escola Secundária de Amarante (Porto)	98.65%	353	Escola Secundária de Gondomar (Porto)	88.15%
138	Escola Secundária Jorge Peixinho (Setúbal)	98.58%	354	Escola Secundária Santo André-Barreiro (Setúbal)	88.06%
139	Escola Secundária D. João V - Damaia (Lisboa)	98.57%	355	Escola Secundária da Mealhada (Aveiro)	88.02%
140	Escola Secundária Dr. António Carvalho Figueiredo (Lisboa)	98.51%	356	Escola Secundária/3 de Latino Coelho (Viseu)	87.97%
141	Escola Secundária Francisco Simões (Setúbal)	98.50%	357	Escola Secundária de Mira de Aire (Leiria)	87.87%
142	Escola EB 2,3 Padre Martins Capela (Braga)	98.46%	358	Escola Secundária de Rio Tinto (Porto)	87.74%
143	Escola Secundária Passos Manuel (Lisboa)	98.44%	359	Escola Secundária Engº Acácio Calazans Duarte (Leiria)	87.66%
144	Escola Secundária de Barcelos (Braga)	98.40%	360	Escola Secundária Marques de Castilho (Aveiro)	87.58%
145	Colégio Dr. Luís Pereira da Costa (Leiria)	98.32%	361	Escola Secundária de Paços de Ferreira (Porto)	87.48%
146	Escola Secundária de Vendas Novas (Évora)	98.22%	362	Escola Secundária Camilo Castelo Branco - Vila Real (Vila Real)	87.24%
147	Escola Secundária Diogo de Gouveia (Beja)	98.21%	363	Escola EB 2,3/S de Caminha (Viana do Castelo)	87.20%

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Escola Secundária Felismina Alcântara				
148 - Mangualde (Viseu)	98.20%	364	Escola Secundária de Lousada (Porto)	87.16%
Escola Secundária do Monte da			Escola EB 2,3/S José Falcão (Miranda do	
149 Caparica (Setúbal)	98.19%	365	Corvo) (Coimbra)	87.15%
150 Escola Secundária de Pinhel (Guarda)	98.15%	366	Escola EB 2,3 de Murça (Vila Real)	87.02%
			Colégio Diocesano de Nossa Senhora da	
151 Externato D. Fuas Roupinho (Leiria)	98.10%	367	Apresentação (Aveiro)	86.86%
Escola EB 2,3/S de Baixo Barroso (Vila			Externato Liceal Torre Dona Chama	
152 Real)	98.07%	368	(Bragança)	86.80%
Escola Secundária Dr. Ginestal			Escola Secundária de Mogadouro	
153 Machado (Santarém)	98.06%	369	(Bragança)	86.78%
Escola Secundária com 3º Ciclo			Escola Secundária Soares Basto - Oliveira	
154 Fernando Namora (Coimbra)	98.05%	370	de Azeméis (Aveiro)	86.73%
			Escola Secundária Rodrigues de Freitas	
155 Colégio Santo André (Lisboa)	98.02%	371	(Porto)	86.53%
Colégio Nossa Senhora da Bonança				
156 (Porto)	97.97%	372	Escola EB 2,3/S de Baião (Porto)	86.50%
157 Escola Secundária de Fafe (Braga)	97.94%	373	Escola EB 2,3/S de Mora (Évora)	86.36%
			Escola Secundária de Romeu Correia -	
158 Escola Secundária da Maia (Porto)	97.76%	374	Feijó (Setúbal)	86.35%
Escola Secundária Maria Lamas				
159 (Santarém)	97.74%	375	Colégio de Campos (Viana do Castelo)	86.31%
			Escola EB 2,3/S Ribeiro Sanches (Castelo	
160 Externato João Alberto Faria (Lisboa)	97.72%	376	Branco)	86.21%
Escola Secundária de Oliveira do Douro				
161 (Porto)	97.60%	377	Externato D. Afonso V (Lisboa)	86.08%
Escola EB 2,3/S de Melgaço (Viana do				
162 Castelo)	97.58%	378	Escola Secundária de Vouzela (Viseu)	85.90%
Escola Secundária Dr. João Carlos C.				
163 Gomes - Ílhavo (Aveiro)	97.48%	379	Escola EB 2,3/S de Rio Caldo (Braga)	85.89%
164 Externato Infante D. Henrique (Braga)	97.45%	380	Escola EB 2,3 de Maceira Lis (Leiria)	85.80%
Escola Secundária com 3º Ciclo de			Escola Secundária Dr. António Granjo (Vila	
165 Alpendurada (Porto)	97.26%	381	Real)	85.64%
Escola Secundária de Caldas das			Escola Secundária com 3º Ciclo de Nelas	
166 Taipas (Braga)	97.23%	382	(Viseu)	85.63%
Centro de Estudos de Fátima - CEF				
167 (Santarém)	97.16%	383	Colégio La Salle (Braga)	85.49%
Escola Secundária André Gouveia			Escola Secundária D. Dinis (Coimbra)	
168 (Évora)	97.11%	384	(Coimbra)	85.43%
Escola Secundária Dr. Bernardino				
169 Machado (Coimbra)	97.10%	385	Externato Ellen Key (Porto)	85.38%
Escola Secundária com 3º Ciclo de			Escola EB 2,3/S Prof. Mendes Remédios -	
170 Adolfo Portela (Aveiro)	97.04%	386	Nisa (Portalegre)	85.36%
			Escola Secundária Júlio Dinis de Ovar	
171 Escola Secundária de Arouca (Aveiro)	97%	387	(Aveiro)	85.32%
			Escola Secundária Fernando Lopes Graça	
172 Escola ES/3 D. Egas Moniz (Viseu)	96.99%	388	- Parede (Lisboa)	85.30%
Escola Secundária D. Manuel Martins			Escola Secundária com 3º Ciclo José	
173 (Setúbal)	96.98%	389	Macedo Fragateiro - Ovar (Aveiro)	85.29%
174 Escola Secundária da Anadia (Aveiro)	96.97%	390	Escola Secundária de Amares (Braga)	85.24%
Escola Secundária de Palmela			Escola EB 2,3/S Pedro Álvares Cabral -	
175 (Setúbal)	96.97%	391	Belmonte (Castelo Branco)	85.04%
Escola Secundária Padre Alberto Neto			Escola Secundária de Figueiró dos Vinhos	
176 (Lisboa)	96.94%	392	(Leiria)	85.03%
Escola Secundária Nuno Álvares			Escola EB 2,3/S Paredes de Coura (Viana	
177 (Castelo Branco)	96.90%	393	do Castelo)	85%
Escola Secundária com 3º Ciclo Drª			Escola EB 2,3/S Dr. João de Brito	
178 Maria Cândida (Coimbra)	96.89%	394	Camacho-Almodôvar (Beja)	84.88%
Escola Secundária Madeira Torres			Escola Secundária Seomara da Costa	
179 (Lisboa)	96.86%	395	Primo (Lisboa)	84.70%
180 Escola Secundária de Alvide (Lisboa)	96.86%	396	Cooperativa de Ensino Didáxis (Braga)	84.66%
181 Escola Secundária da Senhora da Hora	96.81%	397	Escola Secundária Alves Redol (Lisboa)	84.40%

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	(Porto)			Escola EB 2,3/S de Barroselas (Viana do Castelo)	
182	Escola Secundária de Valbom (Porto)	96.81%	398	Escola Secundária Camilo Castelo Branco-V.N.Famalicão (Braga)	84.30%
183	Escola Secundária Henriques Nogueira (Lisboa)	96.78%	399	Escola Secundária Diogo de Macedo (Porto)	84.08%
184	Escola Secundária da Lousã (Coimbra)	96.62%	400		84.06%
185	Escola Secundária Joaquim Araújo (Porto)	96.57%	401	Escola EB 2,3/S Ourique (Beja)	83.83%
186	Escola Secundária Stuart Carvalhais (Lisboa)	96.51%	402	Escola Secundária do Montejunto (Lisboa)	83.66%
187	Escola Secundária Afonso Lopes Vieira (Leiria)	96.50%	403	Colégio Dinis de Melo (Leiria)	83.58%
188	Escola Secundária Rocha Peixoto (Porto)	96.45%	404	Escola Secundária de S. Pedro da Cova (Porto)	83.48%
189	Escola EB 2,3 Sacadura Cabral (C.Beira) (Guarda)	96.42%	405	Escola Secundária de Vila Real de Santo António (Faro)	83.41%
190	Escola EB 2,3/S Dr. ^a Maria Judite Serrão Andrade - Sardoal (Santarém)	96.40%	406	Escola Secundária Rainha Santa Isabel - Estremoz (Évora)	83.31%
191	Escola Secundária de Santa Comba Dão (Viseu)	96.37%	407	Escola EB 2,3/S de Alfandega da Fé (Bragança)	83.03%
192	Cooperativa de Ensino Ancorensis (Viana do Castelo)	96.36%	408	Escola Secundária de Mação (Santarém)	82.95%
193	Escola Secundária de Aljustrel (Beja)	96.35%	409	Escola EB 2,3/S Dr. José Leite Vasconcelos (Viseu)	82.95%
194	Instituto Nun'Álvares - Santo Tirso (Porto)	96.34%	410	Escola Secundária Marquesa de Alorna (Almeirim) (Santarém)	82.80%
195	Escola Secundária António Sérgio (Porto)	96.27%	411	Escola Secundária Gil Vicente (Lisboa)	82.16%
196	Escola Secundária Clara de Resende (Porto)	96.24%	412	Escola EB 2,3 Dr. José Casimiro Matias (Guarda)	81.84%
197	Escola Secundária Poeta Joaquim Serra (Setúbal)	96.13%	413	Escola EB 2,3 de Penalva do Castelo (Viseu)	81.65%
198	Externato de Penafirme (Lisboa)	96.11%	414	Escola EB 2,3 de Ribeira de Pena (Vila Real)	81.61%
199	Escola Secundária Ibn Mucana (Lisboa)	96.05%	415	Escola Secundária Matias Aires (Mira-Sintra) (Lisboa)	81.10%
200	Escola Secundária de Carcavelos (Lisboa)	96.05%	416	Escola Secundária Miguel Torga (Bragança) (Bragança)	80.88%
201	Escola Secundária Emídio Navarro (Almada) (Setúbal)	96%	417	Escola EB 2,3/S José Gomes Ferreira - Ferreira do Alentejo (Beja)	80.83%
202	Escola Secundária D. Sancho I (Braga)	95.87%	418	Escola Secundária de Santo António (Setúbal)	80.33%
203	Escola Secundária Dr. Bento da Cruz (Vila Real)	95.84%	419	Cooperativa de Ensino de Coimbra (Coimbra)	79.83%
204	Escola Secundária de Montemor-o-Novo (Évora)	95.82%	420	Escola EB 2,3 de Aguiar da Beira (Guarda)	79.66%
205	Escola Secundária da Azambuja (Lisboa)	95.81%	421	Escola Secundária/3 de Castro Daire (Viseu)	78.54%
206	Escola Secundária Prof. Ruy Luís Gomes (Setúbal)	95.80%	422	Escola Secundária Infante D. Henrique (Porto)	77.98%
207	Escola EB 2,3/S de Pedro da Fonseca (Castelo Branco)	95.80%	423	Instituto Militar dos Pupilos do Exército (Lisboa)	77.53%
208	Escola Secundária de Águas Santas (Porto)	95.64%	424	Instituto de Almalaguês (Coimbra)	77.40%
209	Colégio Bartolomeu Dias (Lisboa)	95.59%	425	Escola EB 2,3/S Pedro Ferreira (Santarém)	77.26%
210	Escola Secundária de Maximinos (Braga)	95.58%	426	Escola EB 2,3 c/ES de S. Martinho do Porto (Leiria)	76.76%
211	Escola Secundária do Bombarral (Leiria)	95.47%	427	Instituto Vaz Serra-Soc.Ensino,Cult.e Recreio (Castelo Branco)	75.96%
212	Escola Secundária com 3º Ciclo Afonso de Albuquerque (Guarda)	95.46%	428	Escola Secundária / 3º Ciclo do Cerco (Porto)	75.21%

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213	Escola Secundária de Condes de Resende (Porto)	95.37%	429	Escola EB 2,3/S Dr. Isidoro de Sousa (Évora)	72.72%
214	Escola Secundária D. Dinis (Santo Tirso) (Porto)	95.36%	430	Escola EB 2,3/S D. Afonso III (Bragança)	72.13%
215	Escola Secundária Augusto Gomes (Porto)	95.28%	431	Escola Básica Integrada de Pampilhosa da Serra (Coimbra)	42.66%
216	Colégio Nossa Senhora da Assunção (Aveiro)	95.19%			