

THE TEACHING OF MATHEMATICS IN THE SPANISH AND BRITISH EDUCATION SYSTEMS

Elena Misa Borrego¹, Juan Núñez Valdés²

Dpt. Geometry and Topology. University of Seville C/ Tarfia s/n. 41012-Sevilla (Spain)

¹Email Address: elena.misa.borrego@gmail.com: ²Email Address: jnvaldes@us.es

ABSTRACT

The authors want to analyse the differences between the British and the Spanish education systems regarding the secondary education of Mathematics. The objective is to provide a different point of view for Spanish teachers, who can take advantage from the British system characteristics, being at the same time a reference for the changes in the Spanish system with the new educative reform approved with the Organic Law on the Improvement of the Quality of Education. Some comments on the university education in both systems are also indicated, with the objective of highlighting the main differences between them. As main conclusions, the British system is more graphic and pragmatic teaching mathematics, while the Spanish system provides a better theoretical basis.

Keywords: teaching; Mathematics; British curriculum; Spanish curriculum; secondary education.

INTRODUCTION

One of the goals of this paper is to compare the teaching of mathematics in the Secondary Education between Britain and Spain. It is intended that Spanish teachers can acquire a better knowledge of the main features of the British educational system. In the same way they can take advantage of those educational aspects they might find interesting in order to enhance their teaching and to motivate their students, arousing interest and curiosity.

In order to analyse this comparative, the authors have made use of the teaching experience realised by one of them, Secondary Education Master's Degree student at the University of Seville in the specialty of Mathematics, during her internship (April 2015) at the British School of Seville, under the indirect guidance of the other author.

The following topics are developed in this paper: comparative analysis between Spain and Britain on the organization of the Secondary Education, the school calendar, skills vs. competences, high school diploma and mathematics curriculum, ending with some conclusions.

A second goal of the paper is to highlighting the main differences between the British and Spanish university systems in general, not only in terms of Mathematics. Note that regarding Higher Education, both countries were ones of the first signatories of the Bologne Declaration, so they have the same framework of action in this level of education and are part of the Bologna educational

system. However, there exist lots of differences in their applications.

2. COMPARATIVE ANALYSIS BETWEEN THE SPANISH AND BRITISH SYSTEMS

Below are the main differences between the Spanish and British education systems, particularly when it concerns to the discipline of Mathematics in the Secondary Education.

2.1 SECONDARY EDUCATION ORGANIZATION. SCHOOL YEAR CALENDAR

Both systems guarantee Primary and Secondary free education, although the schooling years and the structure are slightly different.

In the Spanish system the Secondary Education is divided into two stages. The first stage encompasses the first two years and the second one the last two years. It is worth mentioning that the Organic Law for the Improvement of Educational Quality (from now on LOMCE) modifies these stages turning the first one into three years and remaining only 4^oESO as a single course for the second stage.

Meanwhile, the British system, which is also divided into two stages: Key Stage 3 and Key Stage 4 goes on till five years instead of four, starting and finishing the Primary Education a year earlier than in Spain. This can be explained considering that the British compulsory education begins at age 5, not as 6 as the Spanish, being the high school ages between 11 and 16 years old. KS3 encompasses the first three courses (years 7, 8 and 9) while the KS4 is composed of the last two (10 and 11 years).

There are major differences in the structure of the school year calendar to be followed by both countries. While the academic year is divided into three quarters throughout the year, each quarter of the British system comprises two school periods alternated with a week holiday following this scheme: 1 month school / 1 week holiday / 1 month school / 1 week holiday. In Spain, however, each quarter has only one school period followed by a variable interval of holidays. Quarter 1 / Christmas holidays (2 weeks) / Quarter 2 / Easter holidays (1 week) / Quarter 3 / summer holidays (over 2 and a half months). This calendar should be added each township local holidays.

2.2 AIMS AND COMPETENCES

In 2006, with the Organic Law of Education (LOE), the term competency is introduced into the Spanish curriculum. For the first time in our educational history, the legislation provides a series of basic skills to overcome by the students beyond the curriculum contents.

This pedagogical point of view was already implemented in some math classes, where real life problems were included in some units. The new Spanish educational law goes further, aiming to work all the basic skills, not just from mathematics, but from all different subjects. Moreover, the LOMCE gives equal weight to the achievement of each stage objectives and to the acquisition of competences that students have made, and extends its application to non-compulsory education: during the upper secondary education.

Regarding the British system, the general aims for this compulsory stage follow. It should enable all young people to become:

- Successful learners, who enjoy learning, make progress and achieve.
- Confident individuals who are able to live safe, healthy and fulfilling lives.
- Responsible citizens who make a positive contribution to society.

Some of these aims are similar to those established by the Spanish regulations, although this one develops more their description and adds more.

The British statutory curriculum does not involve competences nor is intended to cover all the basic skills, classification that coincides with the multiple intelligences concept defined by Gardner in 1988 (see Gardner (1994)).

However, the current British curriculum, published in October 2013, includes a series of personal skills and abilities which may be well likened to the Spanish concept of competences. In the subject of Mathematics, the specific aims are as follow (listed because of their extension):

1. Develop their mathematical, oral and writing, skills in order to boost their self-confidence and personal satisfaction and enjoyment.
2. Read mathematics, writing and speaking about a topic in different ways.
3. Develop their ability for numbers, solve problems and interpret the results.
4. Apply mathematics in everyday situations and know how to develop and understand the role they play in the world that surrounds them.
5. Solve problems, give the solutions clearly, review and interpret the results.
6. Use mathematics as a way of communication with emphasis on the use of a clear expression.
7. Develop the ability to use mathematics in other subjects, particularly those of science and technology. Develop the ability to reason logically, classify, generalize and test.
8. Appreciate patterns and mathematical relationships.
9. Produce and appreciate creative work arising from mathematical ideas.
10. Develop your own math skills considering problems and conducting individual and group researches and experiments.
11. Appreciate the independence between the different branches of mathematics.
12. Acquire a base knowledge in accordance to further studies of mathematics and/or other disciplines.

As we can see above, all the objectives are strictly related to mathematics, as in the Spanish system is intended to promote the ability of students to apply their mathematical skills to other subjects and problems of real life.

While in the Spanish system we talk about key competences, the British system speaks of skills (abilities), but both pursue the development of skills and abilities in students.

2.3 THE CLASSROOMS

Although it is true that the situation has improved a lot in Spain in the last times, and one can already see Spanish classrooms well equipped and with greater comforts, it is also certain that still, in general, British classrooms are better and more gifted than those of Spanish ones. Indeed, British classrooms are full of motivating elements. We can find inside of them a lot of posters, flashcards,

pictures, maps, among many others, apart from the whiteboard and a laptop, which gives teachers thousands of opportunities to carry out more interesting and attractive activities for their pupils. All of them have computers connected to the internet.

However, in Spain these resources, particularly the connection to the internet, have not yet been fully installed in the classrooms, although it is expected that in a short time it has been possible to remedy these deficiencies. These resources would greatly improve the way of studying of the students and thus their performance. Do not forget that getting the motivation of the students is essential because at the age of them at this level is quite short and they need to feel that what they are doing is interesting for them.

In addition to these mentioned aspects, another resource used in the British system, but not in the Spanish one, is to motivate pupils in giving them diplomas in order to appreciate their effort in the different subjects. They feel very proud of them and these prizes make students feel the interest and need of going on improving (PUBLI DIDACT).

In any case, fortunately, in Spain the foundations to improve all the aspects of its educational system are laying. To start, the first step that is required to do that, being aware of the need to improve, is already given. Other steps, such as “learning doing” instead of “learning teaching”, to improve the commitment of the teachers with the Education, to admit how important the Education is, the incorporation of the ICT resources in the classrooms, as well as the implementation of bilingual systems are also being considered.

2.4 HIGH SCHOOL DIPLOMA

In the Organic Law of Education, Spanish legislation for the first year of each stage, the students who have acquired the basic competences and aims of the stage will be awarded the Diploma in Secondary Education. This means having passed all the subjects in the final year of the Secondary (4ºESO), as well as a suitable qualification of their key competences.

The new regulation, LOMCE, introduces a new requirement that approaches more the Spanish system to the British. Besides having passed the subjects of each stage, students must pass an individualized general assessment, which characteristics and contents will be established by the Spanish Ministry of Education. So far it is not clear how these exams will but we can be guided by those being made in the UK.

In British high schools KS4 students have to pass an official exam written up by each Examining Board recognized to grant the Secondary Education Certificate and consists of a series of tests where both the theoretical and basic skills are assessed to gain this level. They are called GCSE exams (General Certificate of Secondary Education), which contents determine to a large extent the curriculum for each subject in these years.

Overall the assessment system is far more flexible than the Spanish, not being regulated by any law. Each school can decide how to asses although all students must pass the official certificates for each stage of their education.

Textbooks from the previous stage to the GCSE, KS4, have an agenda that covers the entire content of the official exams. Nothing else or left is taught out from what it may come in the exam. In fact the publishers belong to the same Examining Boards, see the case of the University of Cambridge, for example.

The IGCSE has two different types. The minimum qualification to pass the exam (equivalent to 60% of the mark) is C, which can be obtained with the completion of a Core exam. The Core exam excludes the most difficult contents of the agenda, ensuring the pass to those students with learning difficulties. However, if they decide to go for the full exam, Extended, they can reach an A mark, the highest. All the contents from the exam concern to the following branches of mathematics: Numbers, Algebra and graphs, Geometry, Measurement, Geometry, Trigonometry, Matrices and transformations, Probability and Statistics. The exam has a total of 4 parts: Paper 1, Paper 2, Paper 3 and Paper 4 (see Morrison, Hamshaw (2012)).

Students who choose to go for the Core exam have to do papers 1 and 3. Paper 1 has one hour duration and contains short questions having a weight of 35% within the overall test score. Paper 3 lasts two hours and consists of structured questions with which the remaining 65% of the mark is obtained.

Students who decide to stand for the Extended exam have to make papers 2 and 4. The paper 2 has one hour and half duration and consists of short questions having a weight of 35% within the overall test score. Paper 4 lasts for two hours and consists of structured questions with which the remaining 65% of the mark (see Table 1) is obtained.

Component	Weighting
1 (Core) 1 hour answer questions based on the Core curriculum. marks. Externally marked.	35%
2 (Extended) 1 hour 30 minutes answer questions based on the Extended curriculum. marks. Externally marked.	35%
3 (Core) 2 hours structured questions based on the Core curriculum. marks. Externally marked.	65%
4 (Extended) 2 hours 30 minutes structured questions based on the Extended curriculum. marks. Externally marked.	65%

Table 1. Percentages of each paper for the IGCSE

While in the Spanish system proposed by the LOMCE there would be a single institution conducting the exam, the Ministry of Education, in the UK there are five Examining Boards: The tests are carried out between May and June, the results not being published until mid-August

2.5 THE INSPECTION

The Inspection Service is also different in both systems. British inspectors want to find out how good a school is and how it might be better. Teachers and parents tell them their opinion about the school and later, they will receive a report. Inspectors decide if the school is “Beacon school” (an example for the others) or if they give the school another opportunity to do improvements.

In the Spanish education system, the inspections are not as rigorous as in the British one. Inspectors are much less demanding in terms of the learning than in the British system and are more focused on the bureaucratic aspects of teaching than on monitoring what students actually learn in the classroom. The demands made to teachers to complete thousands of reports, documents that, although in their correct measure it is true that are positive and necessary, take a long time to the teachers, which, logically, greatly diminishes the attention that these must employ with their students.

3 MATHEMATICS CURRICULAR CONTENTS

If we compare the structure of contents during the final year of the Secondary Education in both countries, always considering the current regulations LOE, we can see that both follow a similar structure but are different in the depth reached for each one of the subject branches.

Analysing in detail the contents of both educational systems for the final year of the Secondary School and based on textbooks in use in both systems: Cambridge IGCSE Maths Student Book and Matemáticas-Pitágoras 4ºESO opción B (see Pearce (2011) and Vizmanos et al. (2011), respectively), it can be observed that both follow similar blocks of contents, although there are some differences to note between the two countries:

- In the Spanish system polynomials are studied in depth, while in Britain are introduced as part of the equations.
- Percentages, ratios, rates and rounding are only seen in the Spanish system in lower stages.
- The British system does not study logarithms till the A level.
- The Spanish system does not study the different ways to write the numbers at this level: standard and normal form.
- In Spain matrices are not studied till Bachillerato (Spanish equivalent to the A level), however the scalar product and the equations of the line (parametric, continuous, comprehensive and explicit) are studied.
- The Spanish system deepens more in teaching trigonometry: radians, goniometric circumference, sine and cosine theorems.

- In Spain functions are less studied as graphics applied to practical situations, whereas the study of them is much more systematic and pursues that students are able to translate from the algebra form to graph of any given function.
- In the British system straight lines and parabolas are studied, while the Spanish also studies exponential, logarithmic, inverse proportionality and trigonometric functions.
- In the Spanish system limits and continuity of functions, moreover the concept of derivative is introduced (if the timing of the course allows it).
- The Spanish system deepens more in combinatorial analysis. In addition to studying tree diagrams (as in the British system), permutations, combinatorial numbers and the powers of a binomial are also studied.
- While the British system develops the one-dimensional statistics, the Spanish also teaches two-dimensional statistics with the linear correlation coefficient, regression and covariance.

4 COMPARATIVE ANALYSIS BETWEEN THE UNIVERSITARY SPANISH AND BRITISH SYSTEMS

In this last section of the paper we have a look at the higher-educational opportunites in Spain and in the United Kingdom.

Regarding Higher Education, both countries were ones of the first signatories of the Bologne Declaration, so they have the same framework of action in this level of education and are part of the Bologna educational system.

The Bologna Declaration (in full, Joint Declaration of the European Ministers of Education) is the main guiding document of the Bologna process. It was adopted by ministers of education of 29 European countries at their meeting in Bologna on 19 June 1999.

It proposed a European Higher Education in which students and graduates could move freely between countries, using prior qualifications in one country as acceptable entry requirements for further study in another.

The principal aims agreed were:

Adoption of a system essentially based on two main cycles, undergraduate and graduate. The degree awarded after the first cycle shall also be relevant to the European labour market as an appropriate level of qualification.

Later, the Bergen meeting subsequently refined the second point, and produced a three-cycle framework of qualifications, which in the UK terminology (adopted, at least partially, by many European countries) knowledge by developing a substantial body of work.

This Bologna declaration has later been followed up a series of meetings between EU ministers. Louvain-la-Neuve communiqué (2009), the Bologna Ministerial Anniversary Conference in

Budapest (2010), the Bucharest communiqué (2012) and finally, the Yerevan communiqué (May 2015). In this last meeting, the Education Ministers identified four key priorities for the future:

- 1.- Enhancing the quality and relevance of learning and teaching.
- 2.- Fostering the employability of graduates throughout their working lives.
- 3.- Making our systems more inclusive.
- 4.- Implementing agreed structural reforms.

Regarding university education (also called tertiary education), in Spain, after the Secondary educational period, students have 2 possibilities: continuing their studies with 2 more years of baccalaureate, which are mainly focused on preparing them to the university, or going to the vocational education which is composed of workshops that teach them to be a manual worker in different fields.

As usual, Spanish students usually don't take seriously their studies for different reasons, mainly due to that the universities have been decreasing their requirements and the level to pass the course has decreased and the fact that many students do not study what they want because of the social influence (many people study majors just because the social influence suggests "you have to go to the university, it doesn't matter what you study").

It is true that many students have high level studies, but they do not have any passion about them and are not ambitious with their career. At this respect, it is convenient to note that in a report published in the "Diario de Sevilla" journal, dated 13 July 2017, the "Fundación Conocimiento y Desarrollo", which analyzes the evolution of Spanish universities (50 public and 32 private), affirms that 36.8% of all Spanish graduates who worked last year occupied jobs that required a lower qualification than they had.

Moreover, in the recent years, this has become stronger due to the economical crisis, because everybody has wanted to study something in order to have some perspectives. This, which in principle is negative, has also had a positive part, since many people are developing new ideas, starting to create their own business and initiatives and being creative to deal with the negative situation around, which is contributing to improve the situation, although there is still much to do.

On the contrary, England, particularly, is one of the countries that welcome the most international students, providing a truly multicultural environment. Generally, the students come from different backgrounds and are interested in diversity and seek a creative environment to gain knowledge, and socialize at the same time (Desfuli and Szirb, 2013). Universities like Cambridge, Oxford or University College London occupy top places amongst the best universities in the world and they are also known for having the largest tuition in the European educational system (Desfuli, Szirb, 2013).

Britain has 89 universities, including the Open University, and 70 other HE institutions. British

universities can be divided into three groups:

- Oxford (founded in 1167) and Cambridge (1229) - the oldest and most famous universities. In Scotland there are St. Andrew's (1411), Glasgow (1451), Aberdeen (1494) and Edinburgh (1583).

- "Redbrick universities" which were founded in 19th century - London (1836), Manchester (1851), Wales (1893).

- Universities opened in 20th century, mostly after 1960 - Bristol, Birmingham, Liverpool, Reading, Nottingham, Exeter, Sussex, York. One in the 1960s when such universities as Sussex in Brighton, York (both 1963), Warwick in Coventry, Kent in Canterbury were established. The other wave came in the 1990s when 39 new universities were created.

One can also find the Open University, an institution for adults (established in 1969). No formal academic qualifications are required to enrol in undergraduate courses, but the standards of its degrees and other qualifications are as high as other universities.

The greatest advantage that the British universities offer is the prospect and high chance of finding a job in the studied field after graduation, reason for which many international students choose to continue to live in England where they have the possibility to get into the desired workplaces, in Spain the opportunities which the graduates have when they have finished their studies are very limited. It implies that the vast majority of students who cannot find a job and are not so valiant to move abroad are starting to study new master degrees just to be occupied or are learning foreign languages (see (Web1) for a further information on all these aspects).

5. CONCLUSION

In the literature one can find several papers that analyze and compare the educational systems of different countries in the world (see Gundala, 2016; Kariwo, Gounko and Nungu, 2014; König, Lüttinger and Müller 1988, Sánchez, 2011 or Monsalveand Cebrián, 2015, for instance). However, there are not so many dedicated to analyzing the treatment of specific subjects in different systems (Literature, for instance, in (Dörr, Faist, 1997)) and among the latter are very few those dealing with Mathematics in particular (Hodgen et al., 2010, for example).

In this paper, the authors note these differences between the educational systems of Spain and Britain, although particularly focusing on the subject of Mathematics at Secondary and Baccalaureate levels. Some comments on the university education in both systems are also indicated.

In this respect and in view of these considerations mentioned, we can conclude that the British system is more graphic and practical when it comes to mathematical content, while the Spanish system goes more in depth into the theoretical basis.

Personally, the authors think that the English system is more suitable for those students who want to start their professional career once finished the Secondary Education, giving a mathematical knowledge that allows getting on confidently with everyday life problems.

However, we would like to stand out the educational leap suffered by British students between the Secondary Education and the A level (our Bachillerato). They start with a weaker mathematical basis than the Spanish students and have to face very tricky mathematics in order to gain access to technical degrees. Maybe the ideal would be to find a balance that ensures a good training base connecting the academic knowledge to everyday life problems.

On many occasions the Spanish system fails imparting knowledge that is not applied outside the high school walls. For example, would Spanish students (4°ESO) be able to manage a wage in order to live independently? Which taxes do they have to pay and how? We cannot forget that we are training people who can join the job market once they have passed their Secondary Education.

To some extent the English system ensures, through the GCSE exam, all graduated students have assimilated the basic knowledge required. The Spanish system seems to pursue the same goal with the new Secondary certification test, which is still being debated by the government.

REFERENCES

- Desfuli, C., Szirb, E. (2013). Education in Europe. UK and Spain (part III).
http://one-europe.net/education_uk
- Dörr, S., Faist, T. (1997). Institutional conditions for the integration of immigrants in welfare states: A comparison of the literature on Germany, France, Great Britain, and the Netherlands. *European Journal of Political Research* 31:4, 401-426.
- Gardner, H. (2011). *Frames of Mind. The theory of multiple intelligences*. New York: Perseus Book Group.
- Gundala, S. (2016). *Education Systems Around The World: A Comparison*.
<https://www.linkedin.com/pulse/education-systems-around-world-comparison-sashi-gundala>
- Hodgen, J., Pepper, D., Sturman, L., Ruddock, G. (2010). An international comparison of upper secondary mathematics education. National Foundation for Educational Research. Nuffield Foundation.
- Kariwo, M., Gounko, T., Nungu, M. (eds) (2014). *A Comparative Analysis of Higher Education Systems. Issues, Challenges and Dilemmas*. Rotterdam / Boston / Taipei. 214 pages.
- König, W., Lüttinger, P., Müller, W. (1988). A comparative analysis of the development and structure of educational systems. Methodological foundations and the constructions of a comparative educational scale. CASMIN-project number 12, Universität Mannheim.
- Monsalve L., Cebrián, S. (2015). Comparative study between the educational systems of Spain, UK, France and Germany. *Proceedings of the 7th International Conference on Education and New Learning Technologies*, Barcelona, Spain.
- Morrison, K. & Hamshaw, N. (2012). *Cambridge IGCSE Mathematics: Core and Extended Coursebook*. Cambridge University, 3-4.
- Pearce, C. (2011). *Cambridge IGCSE Maths Student Book*. Collins.
- Sánchez Ruiz, A.I. (2011). *Educational Systems: the British and Spanish ones*. Publicaciones Didácticas 13.
<http://publicacionesdidacticas.com/hemeroteca/articulo/013040/articulo-pdf>
- Vizmanos, J.R., Alcaide, F., Serrano, E., Moreno, M. & Hernández, J. (2011). *Matemáticas B Pitágoras 4º ESO Proyecto Conecta 2.0*. Madrid: SM.

IJESSR.COM