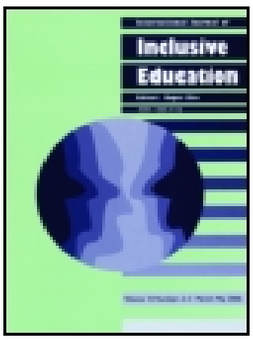

International Journal of Inclusive Education

ISSN: 1360-3116 (Print) 1464-5173 (Online) Journal homepage: http://www.tandfonline.com/loi/tied20

Mixed schools versus single-sex schools: are there differences in the academic results for boys and girls in Catalonia?

Maribel Garcia-Gracia & Trinidad Donoso Vázquez

To cite this article: Maribel Garcia-Gracia & Trinidad Donoso Vázquez (2015): Mixed schools versus single-sex schools: are there differences in the academic results for boys and girls in Catalonia?, International Journal of Inclusive Education, DOI: 10.1080/13603116.2015.1079269

To link to this article: http://dx.doi.org/10.1080/13603116.2015.1079269

Published online: 12 Sep 2015.

International Journal of Inclusive Education, 2015
http://dx.doi.org/10.1080/13603116.2015.1079269

REVIEW

Mixed schools versus single-sex schools: are there differences in the academic results for boys and girls in Catalonia?

Maribel Garcia-Gracia[a*] and Trinidad Donoso Vázquez[b]

[a]*Department of Sociology, Universidad Autónoma de Barcelona, Barcelona, Spain;*
[b]*Department of Pedagogy, Universidad de Barcelona, Barcelona, Spain*

(*Received 23 October 2014; accepted 17 July 2015*)

This study carries out a comparative analysis of achievement according to gender between mixed and single-sex schools in the region of Catalonia, Spain, for the subjects of Spanish, Catalan, English and Mathematics. After a brief contextualisation, a review of the main findings from international studies on differences in results for mixed schools and single-sex schools is then presented. We then outline our methodology and research-analysis plan. The study has been developed around a specific use of results obtained by students over the last year of primary school (12 years old) and over the last year of obligatory secondary education (16 years). For this comparison, the statistical technique of Propensity Score Matching was used. All segregated schools in Catalonia were chosen, representing a total of 15, of which 9 are girls-only and 6 are boys-only (with a total of 1503 students); additionally, a sample was used of 10 mixed schools, similar in terms of social make-up, that is, middle- and upper-class students (with a total of 1217 students). In general, the results corroborate international research. Results indicate that differences in achievement depending on gender in segregated or mixed schools are not related to factors of school organisation. We also come to conclusions with respect to the limitations arising from circumscribing school performance in curricular subjects, and to the need to consider further indicators within the teaching-and-learning process in terms of gender and emotional development; student attitudes and behaviour; self-concept and – most especially – teacher expectations, their teaching practices and the effects of these on self-concept and single-sex school performance.

Keywords: achievement and gender; single sex; co-educational education

1. The research context

The expansion in education that has occurred in Catalonia and Spain over recent decades has led to a democratisation in access to higher education; women in particular have been one of the groups that have most benefitted from this expansion (Baudelot and Establet 1992). This is one of what we might call the 'historical conquests' that has had greatest social impact, particularly in terms of reducing gender inequality (Becky 2002), of increasing the participation of women in the labour market (Borderias 2003) and of changes in personal, professional and family-related expectations (Casal and Garcia 1993), and in the processes of school-to-work transition (Garcia and Merino 2007; Godwin and O'Connor 2007). However, this democratisation has been

*Corresponding author. Email: maribel.garcia@uab.cat

accompanied by two issues that have not yet been resolved by our education systems. First, unequal guidance in the choice of studies offered to boys and girls; current guidance still reproduces gender stereotypes and is the fundamental explanation for the under-representation of girls when opting for technical study and related careers (Fontaine and Ohana 1999; Francis 2000). Second, the high number of early school leavers, which is particularly evident among boys from under-privileged socio-economic and cultural backgrounds (Furlong and Cartmel 1997). These two phenomena show the limitations of our education systems in combating social and gender inequalities. Similarly, the neo-liberal political and economic context and the endorsement of the right of families to choose their schools have revived the traditional debate on the suitability and limitations of mixed schools (Burgess 1990) to which this article will endeavour to contribute. Thus, the work presented here aims to contribute to the ongoing discussion regarding gender inequality in the educational sphere, from the point of view of both the factors influencing this and the analysis of educational results.

As a model for educating boys and girls without gender distinction, mixed schools in Catalonia and Spain are, historically speaking, relatively recent in the sense that they were only introduced in the 1970s. They are characterised by the indistinct co-education of boys and girls, under a same educational model and through the same curriculum. Co-educational school in fact goes one step further: it also refers to an educational model that seeks to transform gender stereotypes by recognising gender differences and inequalities, though from a perspective that is critical of the patriarchal order and androcentrism underlying the traditional educational curriculum and academic 'knowledge' as a whole.

With the exception of the Scandinavian countries, the mixed-school mode was introduced sometime after the Second World War, within the framework of social-democratic educational policies. In certain countries such as Spain, Greece, Austria and Portugal, mixed schools are still more recent, as indicated above. Schools segregated according to gender (hereafter referred to simply as *single-sex schools*) can currently only be found in seven European countries and regions, traditionally limited to the sphere of private and denominational schools (Eurydice 2009); clearly then, these are a minority.[1]

The single-sex model is a concept that has appeared recently in research into inequality in the achievement of boys and girls. These are educational institutions that do not enrol – or enrol very few – students of one gender. There is also the possibility of grouping students of one gender together in one class within a co-educational setting (López-López 2010). One of the theories forwarded in defence of this model is the reduction in male academic failure. Segregated schools would provide a setting more in accordance with male values, as opposed to a mixed school, which some analysts have considered to be 'feminised' in both methodologies and teaching staff, and which might therefore have a bearing on the low results attained by male students (Calvo 2009).

In the USA, the transformation of the majority of Catholic secondary schools to mixed schools in the 1960s and 1970s defined the political context of much related research and also set the parameters of the related controversy. However, the USA differs from other countries in that it has promoted single-sex education over recent years as a political tool to compensate for and to improve the academic performance of students in general, or as a possible alternative method for promoting the education of minority sectors.[2] The arguments in favour of single-sex schools highlight

similarities in the formation of groups, to the detriment of heterogeneous groups, independently of whether these similarities or differences are on the grounds of gender, achievement, ethnic group or other issues. The consequences of this lead to a questioning of the inclusive nature of education systems. We could say, at the risk of simplifying, that if during the 1960s and 1970s the political discourse regarding educational inequalities was 'compensate to make equal', today this discourse highlights the need to 'differentiate to compensate', thereby opening up an old debate about the possibilities and limitations of the school institution to modify existing social inequalities and about understanding models of teaching systems.

2. Studies on achievement and gender

International research into achievement and gender has focused mainly on the USA and the UK. The most notable US research is that by Lee and Bryk (1986), Lee and Marks (1992), Bryk, Lee, and Holland (1994) and Riordan (1990). This research consists of longitudinal studies, based on a national sample (the High School and Beyond in the USA), which started in 1980 and continued until 1992. The conclusions of the study by Bryk and Lee highlight 'the advantages for students of single-sex schools, particularly boys, as regards achievement, as well as a lower degree of these assuming gender stereotypes' (1986, 394).

LePore and Warren (1996) draw opposing conclusions using the same databases. According to the result of this study, the supposed benefits regarding the achievement of boys are not very significant when the initial differences between students in single-sex and 'co-educational' schools are considered. The works of Dale and Miller (1972), Willis and Kenway (1986) and Marsh et al. (1989) also conclude on the lack of benefits of single-sex schools, in terms of either academic or social benefit.

Riordan's (1990) study is noteworthy because, for the first time, initial differences were controlled (capacities, social origin, school policies and school environment) and two significant dimensions were added: ethnic group and social class. The results of this study indicate that boys in single-sex schools score lower in cognitive tests than boys in mixed schools. The latter have higher self-esteem; a greater feeling of control of their environment and a more egalitarian attitude towards the role of women in society than boys in single-sex schools. However, as regards girls' results, single-sex schools appear to favour them, as occurs with the results of boys and girls in minority-group schools (Riordan 1990).

In studies carried out more recently, Mael (2005) conducted an international meta-study examining 112 studies on different aspects of single-sex and mixed schools. Mael considers the effectiveness of single-sex schools compared to mixed schools in terms of quantifiable academic achievement; long-term academic achievement (continuity in education to university); adaptation; emotional development; personal satisfaction and, in terms of school processes, atmosphere or culture and their effects on the results. The results are not conclusive at all. In most of the research analysed (45%), significant differences are not found between both types of schools. Forty-one per cent of the studies reviewed find benefits underlying single-sex schools. Eight per cent of the research highlights the net benefits of the mixed-schooling model and 6% indicates that both types of school present positive and negative aspects in equal measure for the students.

The results of the study by Van de Gaer et al. (2004) do not corroborate the theory that single-sex classes and schools favour achievement for both boys and

girls. Taking into account the socio-economic origin of the student, no differences in achievement are found (consistent with Gilbert and Gilbert 2001; Harker 2000). The better performance of girls in single-sex schools is more related to the selective nature of such schools than to the fact that the girls are being educated separately from boys.

Other studies work on interaction between self-concept, school atmosphere and achievement. On the basis of a documentary analysis of different studies, Clark (2004) offers conclusions on the benefits of single-sex education on girls' self-esteem and self-concept, stating that the mixed-school model reinforces traditional (subordinate) gender roles, has effects on low self-esteem and the achievement of girls in maths and science and generates less dedication from the teaching staff to girls. Younger and Warrington (2002, 2006) come to conclusions that oppose the previous study. The role of the teaching staff as regards their expectations and interactions with respect to gender is a key factor in the reproduction of gender stereotypes beyond the school organisation (mixed or single-sex). Students' perception of study in both types of school also demonstrates little difference between genders (Rogers and Hallam 2010).

More recently, two notable articles – Sullivan (2009) and Sullivan, Joshi, and Leonard (2010) – describe the results of a longitudinal study. The first article focuses on self-concept in different subjects; the second is based on the analysis of continuation of studies. For students at 16 years of age, Sullivan (2009) highlights boys' better self-concept in maths and science in all types of schools, while girls from mixed schools show higher levels of self-concept in English. The effect of teachers' expectations and the perception of method of assessment according to gender once again appear in this study.

The results of the second article (Sullivan, Joshi, and Leonard 2010) support the theory of the benefits of single-sex schools for girls. However, no differences are observed between boys and girls as regards passing national exams and accessing university.

Harker's (2000) study, based on a longitudinal study with a sample of 5300 students in 37 schools in New Zealand, also concludes that the difference in the average academic attainment of girls who attend single-sex as against co-educational schools is more apparent than real. When adequate control is exercised for different levels of ability and for the social and ethnic mix in the two types of school, the initial significant differences between them disappear.

Another subject of related research is curricular choice and its relationship with organisational model. The results of the studies by Francis et al. (2003), and Francis (2000), seem to lend weight to the hypothesis that professional guidance reproduces horizontal gender segregation in both mixed and single-sex schools, and thus, models of school organisation do not necessarily challenge the dominant social models as regards gender stereotypes.

Achievement in science subjects is yet another subject of related research; McEwen, Knipe, and Gallagher (1997) conducted a study in England with the aim of examining the impact of governmental policy on the teaching of science in which achieving levels of excellence is encouraged, as well as assessing performance patterns by boys and girls. The authors point out that the effectiveness of a school (measured in terms of performance results) depends on student's entry skills, social origin and the internal and external characteristics of the school. The high achievement of girls in single-sex schools would be sufficiently explained by the origin and entry skills of such students

in this type of school. According to the authors, from 1985 to 1995, the number of boys who were excellent at science reduced notably. With girls, however, the opposite occurred, except in the case of Catholic schools. Using discussion groups, the authors conclude that girls retain certain stereotypes about specific subjects in the curriculum, and are more likely to achieve levels of excellence in science in 'co-educational' settings.

Another study examining performance differences in science is that of Friend (2006). The study concludes that the differences found are not significant, and points out that 'single-sex classes' were not able to produce a better atmosphere in the classroom. Wong, Young and Fraser (1997) concluded the same, finding that the average socio-educational level of the school population was a more important predictor of the performance of students in science than the type of school (whether single-sex or mixed).

Finally, regarding whether the organisational model benefits ethnic minorities or not, reference to the study by Hubbard and Datnow (2005) should be made. The factors that appear to play a more fundamental role in the success of students with few economic resources and from minority backgrounds are financial support from the state and the presence of proactive teachers with a tendency to look after the students; the intrinsic fact of whether the school is mixed or single-sex does not appear to be as relevant.

Taking into account that there are few conclusive results from the research, it is important to refer to the study by Smithers and Robinson (2006), which assessed the quality of the scientific evidence, found regarding single-sex or mixed education. Their study contributes to questioning, on the one hand, the scientific validity of that part of the literature that defends the merits of single-sex schools and, on the other, the methodological limitations of these studies. The authors' overall conclusion is that all the research aimed at demonstrating the supremacy of one model over the other has failed in its intentions.

3. Objectives, methodology, sample and analysis plan

The main objective of this current research project is to analyse whether there are significant differences in Catalonia in the academic results obtained by boys and girls, depending on the organisational model in which they have been educated, that is, depending on whether they have been attending a mixed or single-sex school. A further objective of this research project is to contrast our results with those obtained in earlier studies. As described in the previous section, some of the studies referred to reach contrasting conclusions (Bryk and Lee 1986; LePore and Warren 1996). Other studies contribute important nuances: for instance, better scores in single-sex schools in the case of girls, but lower scores for boys in the same type of school (Riordan 1990). The non-existence of research with such characteristics in Catalonia and the exceptional opportunity to exploit the micro-data of the results from competence tests taken by Catalan students, through the use of the Propensity Score Matching technique, may all throw some light onto the current academic debate in this topic.

The study is performed on the basis of a specific use of basic-skills test results carried out by the Assessment Agency[3] in 2011 and 2012, for the total number of students enrolled in compulsory education. The tests bring results from Spanish, Catalan, English and Mathematics for the last year of primary education (12 years old) and the last year of lower secondary education (16 years old).

All single-sex schools in Catalonia were chosen, representing a total of 15 schools, 9 of which educate girls only and 6 of which educate boys only. All of these schools provide primary and secondary education, except for one that does not offer secondary. The total number of students from the single-sex schools is 1503, 753 of whom are in primary (407 boys and 345 girls) and 750 in secondary (395 boys and 355 girls).[4]

In order to compare the basic-skills test results obtained by students in single-sex schools with those in mixed schools, we proceeded to select mixed schools for comparison that were also privately owned and located in areas with a middle-high socio-economic level. With this first sample boundary, the potential comparison group in primary education is formed by 161 schools in primary education and by 116 schools in secondary education.

Nevertheless, this initial selection of mixed schools for comparison is not sufficient, since their heterogeneity does not provide guarantees of comparison with single-sex schools.

In order to fine-tune the sample from schools for comparison, we have opted to use the Propensity Score Matching technique, on the basis of the method of 'closest neighbour'. This method allows each single-sex school to be assigned a mixed school that is as similar as possible, through a binary logistic regression, carried out in terms of the following variables.[5]

- Foreign students (of various nationalities), expressed as a percentage of the total number of students enrolled.
- Students with recognised specific educational needs (functional diversity, disabilities), as a percentage of the total number of students enrolled.
- Students who request grants, expressed as a percentage of the total number of students enrolled.
- Student/teacher ratio in the school.
- Availability of upper secondary education (*Baccalaureate*).[6]
- Development of *an innova*tive project within the centre.
- Developing innovative projects aimed at promoting the learning of foreign languages.

We obtained two regression models: one to identify schools of comparison for studying results from the last year of primary education (12 years old) and another for selecting schools for comparing results from the last year of lower-secondary education (16 years old).

As regards the predictive capacity of the model, it classifies schools with a mixed organisation model very well (98.7%), but classifies single-sex schools with less precision. This means that, with the variables considered, certain characteristic features of the schools with a single-sex model can be identified, such as the existence of innovative projects aimed at promoting the learning of foreign languages, which is more frequent in single-sex schools. But there are elements of these 15 schools that are not detected by the model designed. As a result, the adjustment is incomplete for two fundamental reasons: First, the existing diversity among single-sex schools (concerning their educational projects; the teaching-related implementation of their curriculums; their particular projects; etc., with respect to which a quantitative approach is not possible). Second, this difference is partly the result of the technique used, which has difficulties in classifying small groups such as those making up single-sex schools. However, the reduced number of single-sex schools in Catalonia determined our

choice of this technique: as we were dealing with the totality of existing single-sex schools in Catalonia (15), the model's lesser predictive ability for single-sex schools does not alter the final results.

The regression model used for primary education is globally significant. The predictive effectiveness of the model is moderate (with a variance of 0.438, Nagelkerke *R*-squared), but is nevertheless statistically significant. The regression model for secondary education is also globally significant. The predictive effectiveness of the model is considerable (with a variance of 0.459, Nagelkerke *R*-squared), similar to that of the model used for primary education.

This process allowed 10 mixed schools to be selected, similar to the single-sex schools in terms of the high socio-economic setting and the above-mentioned variables. All these schools are private; as a result, they have a concentration of middle- and upper-class families, as also occurs in single-sex schools. The total number of students in the sample is 1217; 497 of these are in primary (258 boys and 239 girls) and 720 are in secondary (392 boys and 328 girls)

Once the pairings were complete, we verified the similitude of the selected sample (mixed schools) with respect to single-sex schools. The regression with matching models has been useful in configuring schools for comparison similar to single-sex schools, since the average values among these are more similar than those obtained for the total of private schools, within the mid-to-high socio-economic context, as observed in Tables 1 and 2.

The following section sets out the results from the analysis carried out. The analysis plan establishes three levels:

First, we compare the mean scores obtained by students in single-sex and mixed schools, regardless of sex, that is, considering the 'organisational model' as the only independent variable.

Second, we introduce a second independent variable, gender, to analyse possible differences between boys in single-sex schools and in mixed schools. Additionally, we analyse possible differences, between girls, in either of these organisational models. This allows us to analyse the influence of the organisational model, separately

Table 1. Equilibrium conditions for the variables in primary education.

	Average for single-sex schools	Average for mixed schools	Average for schools with a low level of complexity and under private ownership
% Foreign students (various nationalities)	0.39	0.31	0.63
Student/teacher ratio in the school (%)	10.70	11.0	11.70
% Students with recognised specific educational needs	5.21	4.75	2.07
% Students who request grants	5.24	5.18	3.82
% Schools with innovative projects aimed at promoting the learning of foreign languages	40	30	11
Availability of upper secondary education (Baccalaureate) (%)	93	85	61
N valid	15	10	161

Table 2. Equilibrium conditions for the variables in secondary education.

	Average for single-sex schools	Average for mixed schools	Average for schools with a low level of complexity and under private ownership
% Foreign students (various nationalities)	0.40	0.46	0.87
Student/teacher ratio in the school (%)	10.75	12.67	11.88
% Students with recognised specific educational needs	5.84	4.83	1.81
% Students who request grants	5.38	4.41	3.78
% Schools with education-innovation projects	57.1	70.0	26.7
% Schools with innovative projects aimed at promoting the learning of foreign languages	57.1	50.0	10.8
N valid	14	10	116

for boys and for girls. Thus, we contrast the hypothesis of whether there are possible differential benefits, in single-sex schools, depending on whether we are focusing on girls, who would obtain better scores, or boys, who would obtain lower scores (Riordan 1990; Sullivan, Joshi, and Leonard 2010).

Third, we analyse the differences between boys and girls enrolled in the same organisational model to assess whether the differences in average scores for boys and girls are amplified or reduced in accordance with the organisational model.

These three levels of analysis are presented separately for performance results obtained by students in primary and secondary education.

4. Comparison of results

If it is assumed that the comparison groups are as similar as possible to the schools as regards the variables mentioned, achievement differences can be interpreted depending on the organisational model (single-sex or mixed schools).

First, the scores obtained by schools in different competencies of the evaluation test for the sixth grade of primary education in 2011 and of the evaluation test for the fourth grade of compulsory secondary education in 2012 were compared using the Wilcoxon parametric test for related samples (Table 3). If the population analysed (schools with the single-sex organisational model) had been greater, it would have been more suitable to apply the *Student's t-test*; but since there are only 15 schools with the single-sex organisational model, a non-parametric test was used. More specifically, a test for related samples was used, since the objective of this study is to determine whether there are differences in the educational results of students depending on the organisational model of the school.

4.1. *Primary education results (12 years old)*

- Are there statistically significant differences in the academic performance of students from mixed and single-sex schools, in primary education, which can be attributed to the school's organisational model?

Table 3. Results according to organisation model of schools: evaluation of primary education, 2011.

Treatment schools	Comparison schools	Wilcoxon test for paired samples
Single-sex schools Boys and girls	Mixed school Boys and girls	Difference between means ($T - C$)
CAT: 80.61	CAT: 80.11	CAT: +0.5
SPA: 80.01	SPA: 78.66	SPA: +1.35
MAT: 84.22	MAT: 84.37	MAT: −0.15
ENG: 89.77	ENG: 87.22	ENG: +2.55**

Source: Education System Evaluation Council.

**Statistically significant difference at 5%.

To respond to this question, we have compared the averages for performance obtained by students in single-sex schools with those obtained by students in mixed schools (i.e. with no gender distinction).

No notable differences are shown between the treatment (single sex) and comparison schools (mixed) in linguistic competence in Catalan or Spanish, but nor in Mathematics. However, a slight statistically significant difference can be observed in the results for English, in which the average obtained in the single-sex schools is 2.5 points higher than that for mixed schools. It should be noted that this might be attributed to the greater presence of girls in the treatment schools, since, of the 15 treatment schools, nine schools are all-girls and six are all-boys. This generates a bias in the comparison, since girls tend to obtain higher scores in linguistic competence than boys. It is, therefore, advisable to analyse whether there are gender-related differences, as described below.

- Are there differences in the academic achievement of boys depending on whether they are schooled in mixed or single-sex schools in primary education? And are there differences in the academic achievement of girls?[7] Is it better, worse or the same for them to be in one type of school or another, depending on the different subjects considered? To answer this question, two populations were differentiated: boys and girls. We then compared the averages for performance obtained by boys in single-sex schools with those obtained by boys in mixed schools. We also compared the averages obtained by girls in single-sex schools with those obtained by girls in mixed schools.

During the analysis, it was observed that the results of students from all-boys schools do not vary significantly from the scores of boys from mixed schools in any of the competences analysed (Table 4).[8]

However, a statistically significant difference can be observed in the scores of girls in foreign languages depending on whether they study in single-sex or mixed schools, although this difference is very slight (less than 1.5 points). As has already been indicated, the overall differences detected in English between the treatment schools and the comparison schools derive from the greater presence of innovation projects aimed at promoting the learning of foreign languages in single-sex schools, which may reinforce the already positive results that girls attain in this type of competence.

Table 4. Results according to organisational model and gender of pupils: evaluation of primary education, 2011.

Treatment schools	Comparison schools	Wilcoxon test for paired samples
Single-sex schools Boys (6 schools)	Mixed school Boys	Difference between means (Boys T − Boys C)
CAT: 77.81	CAT: 77.95	CAT: −0.14
SPA: 77.44	SPA: 76.24	SPA: +1.20
MAT: 85.06	MAT: 85.29	MAT: −0.23
ENG: 88.51	ENG: 85.62	ENG: +2.89
Single-sex schools Girls (9 schools)	Mixed school Girls	Difference between means (Girls T − Girls C)
CAT: 82.47	CAT: 82.71	CAT: −0.24
SPA: 81.72	SPA: 81.07	SPA: +0.65
MAT: 83.66	MAT: 83.77	MAT: −0.11
ENG: 90.60	ENG: 89.12	ENG: +1.48**

Source: Education System Evaluation Council.

*Statistically significant at 10%.

**Statistically significant at 5%.

***Statistically significant at 1%.

- Are the differences in the academic achievement of boys and girls amplified or reduced in accordance with the organisational model (mixed or single-sex school)? To answer this question, we analysed differences in performance between boys and girls in single-sex schools and compared these with differences in performance between boys and girls in mixed schools.

To compare the academic results for both primary and secondary evaluation tests, the Mann–Whitney U test for independent samples was used. As in the previous cases, a non-parametric test was used since the study population is made up of only 15 schools. In particular, a test for independent samples was used as this involved the comparison of two segregated groups (boys and girls) that do not necessarily have the same number of individuals (Table 5).

As regards mixed schools, it transpires that girls obtain higher scores than boys in linguistic competence. Specifically, for English Language the difference is +3.50; for Catalan +4.76 and for Spanish +4.83.

In single-sex schools, however, the disparity in results between boys and girls is less. In Catalan and Spanish, the advantage shown by girls decreases. No statistically significant differences are observed in English (contrary to that which occurs in mixed schools).

Based on the analyses conducted, single-sex schools appear to have very little influence on the performance of students in the evaluation test for the last year of primary education (12 years old), since only a slight difference was observed in English scores between the treatment schools (which score 89.77) and the comparison schools (which score 87.22). This difference must be viewed with caution both on account of the greater presence of girls in the treatment schools, and on account of the difficulty of finding comparison schools that are similar to the treatment group in certain variables

Table 5. Results according to gender of pupils with the same organisational model: evaluation of primary education, 2011.

Single-sex schools Boys (6 schools)	Single-sex schools Girls (9 schools)	Mann–Whitney *U* test for independent samples Difference between means (Boys *T* − Girls *T*)
CAT: 77.81	CAT: 82.47	CAT: −4.66**
SPA: 77.44	SPA: 81.72	SPA: −4.28*
MAT: 85.06	MAT: 83.66	MAT: +1.40
ENG: 88.51	ENG: 90.60	ANG: −2.09
Mixed schools Boys	Mixed schools Girls	Mann–Whitney *U* test for independent samples Difference between means (Boys *T* − Girls *T*)
CAT: 77.95	CAT: 82.71	CAT: −4.76***
SPA: 76.24	SPA: 81.07	SPA: −4.83**
MAT: 85.29	MAT: 83.77	MAT: +1.52
ENG: 85.62	ENG: 89.12	ANG: −3.50*

Source: Education System Evaluation Council.

*Statistically significant at 10%.

**Statistically significant at 5%.

***Statistically significant at 1%.

that can have a particular influence on these results, such as the presence of projects in English.

4.2. *Compulsory secondary-education results (16 years old)*

- Are there statistically significant differences in the academic performance of students from mixed and single-sex schools which can be attributed to the school's organisational model?

By comparing the average scores for both types of centre, a statistically significant difference can be observed only in mathematics, in which results from schools with a single-sex organisational model are two points higher than that from schools with a mixed model (Table 6).

As regards linguistic competence, there are no significant differences in any of the areas assessed.

- When comparing the academic performance of students from mixed and single-sex schools, are there any differences depending on whether the results of boys or girls are being analysed?[9]

There are no statistically significant differences between the results attained by boys studying in schools with a mixed organisational model and those studying in schools with a single-sex model (Table 7).

However, a statistically significant difference can be observed, albeit with a significance level of 5% in the scores attained by girls in mathematics, depending on whether they study in single-sex or mixed schools (+5.18)

Do the differences in the academic performance of boys and girls vary depending on whether they are studying in a centre with a mixed or single-sex model?

As regards schools with a mixed model, girls obtain higher scores than boys in linguistic competence, while boys obtain higher scores in mathematics (Table 8).

In schools with a single-sex model, on the contrary, no statistically significant differences between boys and girls are observed in any of the competences analysed.

Table 6. Results according to organisational model: evaluation of compulsory secondary education, 2012.

Treatment schools Single-sex schools Boys and girls	Comparison schools Mixed school Boys and girls	Wilcoxon test for paired samples Difference between means ($T - C$)
CAT: 78.45	CAT: 78.44	CAT: +0.01
SPA: 80.26	SPA: 80.08	SPA: +0.18
MAT: 78.32	MAT: 76.19	MAT: +2.13*
ENG: 82.07	ENG: 82.47	ENG: −0.40

Source: Education System Evaluation Council.

*Significant difference at 10%.

Table 7. Results according to organisational model and gender of pupils: evaluation of compulsory secondary education, 2012.

Treatment schools	Comparison schools	Wilcoxon test for paired samples
Single-sex schools Boys (6 schools)	Mixed school Boys	Difference between means (Boys T − Boys C)
CAT: 78.21	CAT: 74.68	CAT: +3.53
SPA: 79.25	SPA: 77.23	SPA: +2.02
MAT: 80.05	MAT: 77.05	MAT: +3.00
ENG: 78.65	ENG: 79.62	ENG: −0.97
Single-sex schools Girls (8 schools)	Mixed school Girls	Difference between means (Girls T − Girls C)
CAT: 78.63	CAT: 78.91	CAT: −0.28
SPA: 81.01	SPA: 81.76	SPA: −0.75
MAT: 77.01	MAT: 71.87	MAT: +5.14*
ENG: 84.63	ENG: 84.11	ENG: +0.52

Source: Education System Evaluation Council.

*Statistically significant at 10%.

**Statistically significant at 5%.

***Statistically significant at 1%.

5. Discussion of results

The results of the research show that there are practically no statistically significant differences in the academic achievement of students from mixed and segregated schools that can be attributed to the organisational model. In primary education, there is a slight difference in results for English, in which single-sex schools obtain an average of 2.5 points more than those for mixed schools. However, this difference decreases to 1.5 when we compare the scores achieved by girls in English in single-sex and mixed schools. The fact that the single-sex schools have more projects promoting foreign languages can partly explain the small difference. Indeed, having foreign language projects (a variable used in the construction of the comparative sample) has a higher probability of occurring in single-sex schools. No notable differences were observed between one group of schools and another for any of the remaining competences considered.

In secondary education, only a slight difference is observed in mathematics, in which schools with a single-sex organisational model score two points higher than schools with a mixed model.

It can therefore be concluded that, in general, the school's organisational model does not represent any benefit on the academic achievement attained by boys and girls.

These general results have been complemented and qualified with a more detailed analysis of the possible differences in the achievement of boys or girls, depending on whether they are educated in one or another type of school. Research such as that by Van de Gaer, Pustjens, Van Damme, and De Munter (2004) reveals that, in general, boys obtain better results in language in mixed classes, but not in mathematics; while girls make better progress in mathematics in unisex classes, but not in languages. Could this mean that mixed schools might compensate for the slight difference in attainment by boys in languages, while unisex schools might have the same

Table 8. Results according to gender of pupils with the same organisational model: evaluation of compulsory secondary education, 2012.

Single-sex schools Boys (6 schools)	Single-sex schools Girls (8 schools)	Mann–Whitney *U* test for independent samples Difference between means (Boys *T* − Girls *T*)
CAT: 78.21	CAT: 78.63	CAT: −0.42
SPA: 79.25	SPA: 81.01	SPA: −1.76
MAT: 80.05	MAT: 77.01	MAT: +3.04
ENG: 78.65	ENG: 84.63	ENG: −5.98
Mixed schools Boys	Mixed schools Girls	Mann–Whitney *U* test for independent samples Difference between means (Boys *T* − Girls *T*)
CAT: 74.68	CAT: 78.91	CAT: −4.22***
SPA: 77.23	SPA: 81.76	SPA: −4.52***
MAT: 77.05	MAT: 71.87	MAT: +5.18**
ENG: 79.62	ENG: 84.11	ENG: −4.48***

Source: Education System Evaluation Council.

*Statistically significant at 10%.

**Statistically significant at 5%.

***Statistically significant at 1%.

compensatory function for girls in mathematics? It could be thought that the results of our research support these conclusions in part, particularly in relation to achievements in mathematics by girls in single-sex schools. However, these results have a low level of significance (5%) with a percentile difference of +5.18 points.

If differences in results between boys and girls are analysed depending on whether one organisational model or another is in place, in secondary education it can be observed that, in schools with a mixed model, girls obtain higher scores than boys in linguistic competence, while boys obtain higher scores in mathematics. In schools with a single-sex model, however, no statistically significant differences between boys and girls can be observed in any of the competences analysed. Could this mean that single-sex schools contribute to correcting the inequalities of academic achievement for girls and that mixed schools contribute to increasing them, or is this merely a spurious relationship? The results of our research do not help us to clarify this question. The influence of teaching and student expectations on students' academic achievement would have to be considered according to areas of knowledge as well as gender; it would also be necessary to enquire more fully into whether the centre's organisation as a mixed or single-sex model has any type of effect on these expectations.

Our analysis of international research has not provided any conclusive results concerning differences in achievement between genders with respect to the school's organisational model. In the words of Rowe (2000, 27), 'It is important not to over-interpret the importance of these gender and gender/class/school-grouping effects, since they pale into insignificance compared with class/teacher effects – regardless of student gender.'

It is of relevance to point out that our study has certain limitations that should be highlighted. The first is related to methodology, specifically our consideration of a low number of schools using a single-sex model in Catalonia (although in fact all existing schools have been included). Some elements of these 15 schools have not been detected with the model designed; this is due to a lack of available administrative information.

The second limitation is epistemological and is related to the actual subject of the study, focused on output. In this case, academic achievement is measured in four curricular subjects, but other dimensions of the teaching process are omitted (namely, learning that may have more of an influence on eliminating gender stereotypes and building an inclusive school: school atmosphere; the teaching project (in the line with results from Mills and Keddie 2007); socio-emotional development; academic expectations of the teachers and students; relational competencies; attitudes and behaviour; self-concept and emotional education). Diaz Aguado points out that:

> Teaching to build equality through practice requires experiences of collaboration between girls and boys, based on mutual respect, to thereby advance in the overcoming of two of the main conditions underlying gender violence: the unequal distribution of power that exists in society and the resistance to change that this situation produces, especially among men. These cooperative contexts enable the construction of equality to be inserted into a full and coherent treatment of cohabitation. This also contributes to achieving other current challenges, such as interculturality, and helps to distribute protagonism in the classroom, thus reducing the tendency to seek negative protagonism that underlies a lot of disruptive behaviour.[10] (Díaz Aguado 2006, 69)

In this regard, some studies conclude that co-educational schools meet socio-emotional needs and minimise the need for discipline (Schneider and Coutts 1982). Co-

educational schools are, therefore, happier social settings, with a lower degree of anxiety and neuroticism among students and teachers, while these social and emotional advantages have no cost for academic progress (Dale 1974). Emotional relationships are only beginning to be recognised as a critical part of the learning process and as a part of the knowledge base (Beard, Clegg, and Smith 2007; Feeley 2009; Hargreaves 2000, 2001; Lynch, Lyons, and Cantillon 2007; O'Brien 2007, 2008). Some innovative social and emotional education programmes recognise that inter- and intra-personal intelligence has been neglected in education, as has the need to approach development from a holistic perspective (Cohen 2006; Gardner 1993, 1999; Goleman 1996; Sternberg 1998). Furthermore, there is evidence that socio-emotional education has contributed to a reduction in gender violence (Diekstra and Gravesteijn 2003). This, undoubtedly, is a line of research to be explored in Catalonia.

Funding

This work was supported by the Consell Superior d'Avaluació del Sistema Educatiu, Generalitat de Catalunya [grant number 12415].

Notes

1. There are over 400 schools with such characteristics in England, and 120 in Ireland (Eurydice 2009, 91). While in Scotland there is one, in Wales there are 7. Some examples in different geographical contexts: in Malta there are 25 schools of this nature, whereas Greece has 27 religious all-boys public secondary schools. The existence of state schools that educate boys and girls separately is not very common in most countries, although their presence in the private sector is found in almost all countries. In certain cases, these are also financed with public funds, though many others are financially independent. In most cases, these are also denominational schools (Catholic, Protestant or Muslim) and, in many cases, they are selective schools, from the point of view of the social make-up of the student body. This involves a teaching-based orientation that is more centred on tradition than on a determination to question conventional gender models (Eurydice 2009, 87).
2. In 2006, the Bush administration changed the controversial regulation of Title IX of the Law on Gender Equality in Education to enable the differentiation of public schools. Until that point, single-sex education was limited to the private sector. From its origin in 2002, NASSPE (the National Association for the Advancement of Single Sex Public Education) has defended this schooling model. NASSPE was renamed NACE (the National Association for Choice in Education) in November 2011 (http://www.singlesexschools.org).
3. A governmental body run by the Catalan Educational Authority.
4. It is important to observe that, in Catalonia, only a small number of schools (15) are segregated according to gender. All of these 15 schools are the object of this study. Practically, all of these are private Catholic schools. Most receive public funding. They are selective schools, from the point of view of the social make-up of their student body, and educate boys or girls from upper- and middle-class families.
5. Matching with replacement was applied, in which each centre with a mixed organisation model could be used as a partner of different single-sex schools. If a centre could only be used as the partner of another centre once, there would be a risk of pairing schools with very different probabilities that, consequently, would not have any similarities with one other. In such cases, applying matching with replacement reduces the distance between the propensity score of the treatment and comparison schools and helps these to be as comparable as possible.
6. With respect to obligatory secondary education, this variable has been excluded from the model by the construction of the samples from mixed schools in secondary education

because it did not model predictive capacity; it has been replaced by "Number of innovation projects carried out by the school".
7. Comparison of boys from segregated schools – boys from mixed schools and girls from segregated schools – girls from mixed schools.
8. Since the Wilcoxon test considers both the magnitude of the differences and the number of pairs with positive and negative rank, significant differences will only be accepted in those cases in which the majority of treatment schools present a more favourable result than the comparison schools. Those differences that can be explained on the basis of certain schools presenting very favourable results that increase the group average are not accepted as valid.
9. Comparison of boys from single-sex schools and boys from mixed schools, and girls from single-sex schools and girls from mixed schools.
10. (Authors' own translation: original version in Spanish).

Notes on contributors

Maribel Garcia-Gracia is Professor of Sociology of Education and member of the Research Group Education and Work "GRET". His research focuses on educational inequalities, educational pathways and transitions young people after lower secondary school. For more information, see http://grupsderecerca.uab.cat/gret.

Trinidad Donoso Vázquez is Professor of the Department of Research Methods and Diagnosis of Education (MEAS), and member of the Research Group GREDI. She has done her research in the field of Diagnosis in Education and Vocational Guidance from a gender perspective. For more information, see http://www.ub.edu/gredi.

References

Baudelot, R., and Ch. Establet. 1992. *Allez Les Filles*. París: Éditions du Seuil.
Beard, C., S. Clegg, and I. K. Smith. 2007. "Acknowledging the Affective in Higher Education." *British Educational Research Journal* 33 (2): 235–252.
Becky, F. 2002. "Is the Future Really Male? The Impact and Implications of Gender for 14-16 Years Old's Carrer Choices." *Journal of Education and Work* 15 (1): 75–88.
Borderias, C. 2003. "La feminización de los estudios sobre el trabajo de las mujeres en España en el contexto internacional." *Revista de Sociologia del Trabajo* 48: 57–124.
Bryk, A. S., V. E. Lee, and P. B. Holland. 1994. *Catholics Schools and the Common Good*. Cambridge, MA: Harvard University Press.
Burgess, A. 1990. "Co-education: The Disadvantages for School Girls." *Gender and Education* 2 (1): 91–95.
Calvo, M. 2009. *Guía para una educación diferenciada: enseñando a los niños como los niños y las niñas como las niñas.* Córdoba, Andalusia: Toro Mítico.
Casal, J., and M. Garcia. 1993. "Les changements dans la transition des jeunes à la vie adulte à l'Espagne des années 90: transformations dans les modèles d'insertion sociale des femmes." In *L'allongement de la jeunesse, Poitiers, Changement Sociale en Europe Occidentale*, edited by A. Cavalli and O. Galland, 137–151. Paris: Actes Sud.
Clark, I. 2004. "Co-education and Gender: The End of Experiment?" *Education Policy Analysis Archives* 12 (41). http://epaa.asu.edu/epaa/v12n41/.
Cohen, J. 2006. "Social, Emotional Ethical and Academic Education: Creating a Climate for Learning, Participation in Democracy and Wellbeing." *Harvard Educational Review* 76 (2): 201–237.
Dale, R. 1974. *Mixed or Single-Sex School? Volume II: Attainment, Attitudes and Overview.* Londres: Routledge and Kegan Paul.
Dale, R., and P. McC. Miller. 1972. "The Academic Progress of University Students from Coeducational and Single-Sex Schools." *British Journal of Educational Psychology* 42 (3): 317–319.
Díaz Aguado, M. J. 2006. "Peer Violence in Adolescence and Its Prevention from the School." *Psychology in Spain* 10 (1): 75–84.

Diekstra, J. C., and R. F. W. Gravesteijn. 2003. *Effectiveness of School-Based Social and Emotional Education Programmes Worldwide*. Santander, Spain: Fundación Marcelino Botín.

EURYDICE (2009). Diferencias de género en los resultados educativos: Medidas adoptadas y situaciòn actual en Europa. Comisión Europea. https://www.google.es/url?sa=t&source=web&rct=j&url=http://eacea.ec.europa.eu/education/eurydice/documents/thematic_reports/120en.pdf&ved=0CCIQFjAAahUKEwiYgNyE9MbHAhUCPxoKHSGnD0w&usg=AFQjCNFZaRjQivHzrZbncoRU5gwBiSfrRw&sig2=qm84dm7RRETNR33OBgAC3w

Feeley, M. 2009. "Living in Care and Without Love: The Impact of Affective Equalities on Learning Literacy." In *Affective Equality: Love, Care and Injustice*, edited by K. Lynch, J. Baker, and M. Lyons. Londres: Palgrave.

Fontaine, J., and D. Ohana. 1999. "Gender Strategies and Social Representation: The Choice of Scientific Post-Baccalauréat Streams in France." *European Journal of Education* 34 (4): 413–424.

Francis, B. 2000. "The Gendered Subject: Students' Subject Preferences and Discussions of Gender and Subject Ability." *Oxford Review of Education* 26 (1): 35–48.

Francis, B., M. Hutchings, L. Archer, and L. Melling. 2003. "Subject Choice and Occupational Aspirations among Pupils at Girls' Schools." *Pedagogy, Culture & Society* 11 (3): 425–442.

Friend, J. 2006. "Research on Same-Gender Grouping in Eighth Grade Science Classrooms." *Research in Middle Level Education* 30 (4): 1–15.

Furlong, A., and E. Cartmel. 1997. *Young People and Social Change, Individualization and Risk in Late Modernity*. Milton Keynes, UK: Open University.

Garcia, M., and R. Merino. 2007. "Jeunes d'Espagne: vers un nouveau rapport de sexes?" In *Les jeunes et l'agencement des sexes*, edited by H. Ecker and S. Faure, 97–107. Paris: la Dispute.

Gardner, H. 1993. *Multiple Intelligences: The Theory in Practice*. New York: Basic Books.

Gardner, H. 1999. *Intelligence Reframed: Multiple Intelligences for the 21st Century*. New York: Basic Books.

Gilbert, P., and R. Gilbert. 2001. "Masculinity, Inequality and Post-school Opportunities: Disrupting Oppositional Polítics about Boys' Education." *International Journal of Inclusive Education* 5 (1): 1–13.

Godwin, J., and H. O'Connor. 2007. "Continuity and Change in the Experiences of Transition from School to Work." *International Journal of Lifelong Education* 26 (5): 555–572.

Goleman, D. 1996. *Emotional Intelligence*. New York: Bantman Books.

Hargreaves, A. 2000. "Mixed Emotions: Teachers' Perceptions of Their Interactions with Students." *Teaching and Teacher Education* 16 (8): 811–826.

Hargreaves, A. 2001. "Emotional Geographies of Teaching." *Teachers College Record* 103 (6): 1056–1080.

Harker, R. 2000. "Achievement, Gender and Single-Sex/Coed Debate." *British Journal of Sociology of Education* 21 (2): 203–218.

Hubbard, L., and A. Datnow. 2005. "Do Single-Sex Secondary Schools Improve the Education of Low-Income and Minority Students? An Investigation of California's Public Single Gender Academies." *Anthropology and Education Quarterly* 36 (2): 115–131.

Lee. V. E. and A. S. Bryk. "Effects of Single-sex Secondary Schools on Student Achievement and Attitudes." *Journal of Educational Psychology* 78: 381–395.

Lee, V. E., and H. M. Marks. 1992. "Who Goes Where? Choice of Single-Sex and Coeducational Independent Secondary Schools." *Sociology of Education* 65 (3): 226–253.

LePore, P. C. and J. R. Warren. 1996. "The Effectiveness of Single-Sex Catholic Secondary Schooling: Evidence from the National Educational Longitudinal Study of 1988." CDE Working Paper No 96-05, University of Wisconsin-Madison, Center for Demography and Ecology.

López-López, E. 2010. "La escolarización "Single-Sex". ¿Qué dice la investigación educativa?" *Educación XX1* 13 (2): 17–45.

Lynch, K., M. Lyons, and S. Cantillon. 2007. "Breaking Silence: Educating Citizens for Love, Care and Solidarity." *International Studies in Sociology of Education* 17 (1–2): 1–19. doi:10.1080/09620210701433589.

Mael, F. A. 2005. *Single-sex Versus Coeducational Schooling: A Systematic Review*. Washington DC: U. S. Department of Education. Office Planning, Evaluation and Policy Development, Policy and Program Studies Service.

Marsh, H. W., I. Owens, M. R. Myers, and I. D. Smith. 1989. "The Transition from Single-Sex to Co-educational High Schools: Teacher Perceptions, Academic Achievement, and Self-Concept." *British Journal of Educational Psychology* 59 (2): 155–173. doi:10.1111/j.2044-8279.1989.tb03088.x.

McEwen, A., D. Knipe, and T. Gallagher. 1997. "The Impact of Single-sex and Coeducational Schooling on Participation and Achievement in Science: a 10-year Perspective." *Reserch in Science & Technological Education* 15 (2): 223–233.

Mills, M., and A. Keddie. 2007. "Teaching Boys and Gender Justice." *International Journal of Inclusive Education* 11 (3): 335–354.

O'Brien, M. 2007. "Mothers' Emotional Care Work in Education and Its Moral Imperative." *Gender and Education* 19 (2): 159–157.

O'Brien, M. 2008. *Well-Being and Post-Primary Schooling*. Dublin: NCCA.

Riordan, C. 1990. *Girls and Boys in School: Together or Separate?* Nova York, Teachers College Press, Teachers College, Columbia University.

Rogers, L., and S. Hallam. 2010. "Gender Differences in Perceptions of Studying for GCSE." *International Journal of Inclusive Education* 14 (8): 795–811.

Rowe. K. J. 2000. "Celebrating coeducation? Certainly not for academic achievement! An examination of the emergent research evidence." Second National Conference on Co-education, Orange, New South Wales.

Schneider, F. W., and L. M. Coutts. 1982. "The High School Environment: A Comparison of Coeducational and Single-Sex Schools." *Journal of Educational Psychology* 74 (6): 898–906.

Smithers. A., and P. Robinson. 2006. *The Paradox of Single Sex and Coeducational Schooling*. Buckingham: Carmichael Press, University of Buckingham.

Sternberg, R. J. 1998. "Abilities Are Forms of Developing Expertise." *Educational Researcher* 27 (3): 11–20.

Sullivan, A. 2009. "Academic Self-concept, Gender and Single-Sex Schooling." *British Educational Research Journal* 35 (2): 11–20.

Sullivan, A., H. Joshi, and D. Leonard. 2010. "Single-Sex Schooling and Academic Attainment at School and Through the Lifecourse." *American Educational Research Journal* 47 (1): 33–36.

Van de Gaer, E., H. Pustjens, J. Van Damme and A. De Munter. 2004. "Effects of Single Sex Versus Coeducational Classes and Schools on Gender Differences in Progress in Language and Mathematics Achievement." *British Journal of Sociology of Education* 25 (3): 307–322.

Willis, S., and J. Kenway. 1986. "On Overcoming Sexism in Schooling: To Marginalize or Mainstream." *Australian Journal of Education* 30 (2): 132–149.

Wong, A. F., D. J. Young, and B. J. Fraser, 1997. "A Multilevel Analysis of Learning Environments and Student Attitudes." *Educational Psychology* 17 (4): 449–468.

Younger, M. R., and M. Warrington. 2002. "Single-sex Teaching in a Coeducational Comprehensive School in England: An evaluation Based upon students' Performance and Classroom Interactions." *British Educational Research Journal* 28 (3): 353–374.

Younger, M. R. and M. Warrington. 2006. "Would Harry and Hermione Have Done Better in Single-Sex Classes? A Review of Single-Sex Teaching in Coeducational Secondary Schools in the United Kingdom." *American Educational Research Journal* 43 (4): 579–620. http://www.jstor.org/pss/412177