International Journal Educational Psychology
Volume 13, Issue 3, 24th October 2024, Pages 199 – 218

http://dx.doi.org/10.17583/ijep.13664

The Gender Gap in Mathematical Competence and School Effectiveness in the Basque Country (Spain)

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Abstract

National and international assessments consistently report gender differences in mathematics, with boys scoring higher than girls. This study aims to explore whether the gender gap has been overcome in mathematical competence; as well as to check what similarities and differences there are according to the school effectiveness, educational stage, and the Diagnostic Assessment (DA) editions in the Autonomous Community of the Basque Country (ACBC). The study follows a descriptive design with a quantitative methodology, analysing census data on the mathematical competence of 4th grade primary and 2nd grade secondary students during the most recent editions of the DA. The results confirm that mathematics achievement is determined by both the gender gap and school effectiveness. Even so, some positive trends can be observed in the latest editions of the DA and, above all, in the secondary education stage to close the gender gap. The study highlights the need to develop mechanisms for measuring equality in schools in a systematic manner, and reviews some of the strategies and action plans currently being implemented to foster gender equality in the classroom.

Keywords

Gender gap, mathematical achievement, mathematical competence, school effectiveness, STEM education

To cite this article: Oregui-González, E., Azkarate-Morales, A., Lojo-Novo, A., & Bartau-Rojas, I. (2024). The gender gap in mathematical competence and school effectiveness in the Basque Country (Spain). *International Journal of Educational Psychology*, *13*(3), pp. 199-218. http://dx.doi.org/10.17583/ijep.13664

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International Journal Educational Psychology
Volumen 13, Número 3, 24 de octubre de 2024, Páginas 199 – 218

http://dx.doi.org/10.17583/ijep.13664

La Brecha de Género en la Competencia Matemática y Eficacia Escolar en el País Vasco (España)

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Resumen

Las evaluaciones nacionales e internacionales identifican de forma consistente diferencias de género en matemáticas, en las que los chicos obtienen puntuaciones más altas que las chicas. Este estudio pretende explorar si se ha superado la brecha de género en la competencia matemática; así como comprobar qué similitudes y diferencias hay en relación a la eficacia escolar, la etapa educativa y las ediciones de la Evaluación de Diagnóstico (ED) en la Comunidad Autónoma del País Vasco (CAPV). El estudio tiene un diseño descriptivo con una metodología cuantitativa, analizando datos censales de la competencia matemática del alumnado de 4º de primaria y 2º de secundaria durante las últimas ediciones de la ED. Los resultados confirman que el rendimiento en matemáticas está determinado tanto por la brecha de género como por la eficacia escolar. Aun así, se observan algunas tendencias positivas en las últimas ediciones de la ED y, sobre todo, en la etapa de educación secundaria para reducir la brecha de género. El estudio pone de manifiesto la necesidad de desarrollar mecanismos para medir la igualdad en los centros educativos de forma sistemática y repasa algunas de las estrategias y planes de acción que se están aplicando actualmente para fomentar la igualdad de género en las aulas.

Palabras clave

Brecha de género, rendimiento en matemáticas, competencia matemática, eficacia escolar, educación STEM

Cómo citar este artículo: Oregui-González, E., Azkarate-Morales, A., Lojo-Novo, A., y Bartau-Rojas, I. (2024). La brecha de género en la competencia matemática y eficacia escolar en el País Vasco (España). *International Journal of Educational Psychology, 13*(3), pp. 199-218. http://dx.doi.org/10.17583/ijep.13664

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The Incheon Declaration and the Framework for Action for Sustainable Development Goal 4 (UNESCO, 2016) stipulate that Education 2030 should strive 'to guarantee an inclusive and equal quality education and to promote lifelong learning opportunities for all'.

In this sense, the 2019-2022 Framework Plan for Developing Inclusive Schools (Gobierno Vasco, 2019b, p.17) establishes that:

> (...) Inclusive education arises from the conviction that the right to education is a basic human right that is at the heart of a fairer society. Consequently, we must ensure each student can reach the highest possible level of personal development, without their educational environment constituting an obstacle to their progression towards excellence. (...) Everyone's right to education should be guaranteed, which is why, from an ethical conviction based on equality and social justice, education should provide equal opportunities, with no discrimination of any kind (for reasons of capacity, culture, ethnicity, religion, gender or sex, etc.), and should play a transformative role in overcoming economic, social, cultural and personal inequalities. (...) At the end of the different educational stages, all students must have attained a level of achievement in basic soft and discipline-based competences which enables them to enter adulthood and continue to develop. (...) Consequently, excellence and equality are two principles that should go hand in hand.

The Heziberri 2020 Pedagogical Education Model Framework (Gobierno Vasco, 2020, pp. 71-75) identifies 12 basic competences to be developed by students: 5 soft skills (learning to learn; linguistic, digital and media communication; social and citizenship skills; autonomy; and personal initiative); and 7 discipline-based competences (language communication; mathematical competence; scientific competence; technological competence; artistic competence; motor competence; and social and citizenship skills). The recently approved curriculum identifies 8 competencies, including "mathematical competence and competence in science, technology and engineering" (Gobierno de España, 2022a, 2022b; Gobierno Vasco, 2023).

Mathematical competence is one of the main pillars of STEAM (Science, Technology, Engineering, Arts and Mathematics) education. The strategy established in the Basque Country seeks to enable students to simultaneously learn concepts and develop basic competences (both soft skills and discipline-based ones) within a practical problem design and resolution context that aims to foster their scientific-technological abilities and vocation, while at the same time, helping girls overcome existing gender inequalities in this field (European Schoolnet, 2017; Gobierno de España, 2021; Gobierno Vasco, 2021).

At an international level, many studies highlight the existence of gender differences in the PISA (Programme for International Student Assessment) results for mathematical competence, such as girls having a lower performance level than boys in most countries (Ibañez & Formichela, 2017; OECD, 2019; Quiroz et al., 2020). In Spain, boys outperform girls in mathematics by a margin narrowing with every PISA edition (Gobierno de España, 2019).

The latest TIMSS (Trends in International Mathematics and Science Study) report on mathematics achievement (IEA, 2020) shows that: in primary school (4th grade of 58 countries), there are 27 countries with no gender gap, 27 countries where boys score better than girls and 4 countries where girls perform better; while in secondary school (8th grade of 39 countries), there are 26 countries with no gender gap, 6 countries where boys score better than girls and 7 countries where girls perform better. This gender gap is confirmed by Correa (2016), Nosek et al. (2009) and Riegle-Crumb (2005).

Other studies analysed the results of both tests (PISA and TIMSS) and conclude countries with better general gender equality levels have a smaller gender gap in mathematics (Else-Quest et al., 2010), indicating that this gap is not due to innate differences in the capacities of boys and girls (Mizala, 2018).

In Spain, Fuentes and Renobell (2020) reviewed the results obtained in the PISA assessment from 2000 to 2015, observing the existence of a gender gap in mathematical performance (López et al., 2021). Similarly, De la Rica and González (2013) analysed the 2003 to 2009 tests, concluding that the differences in mathematical competence between boys and girls is greater in Spain than in its neighbouring countries (Italy, France and Portugal). This trend was repeated in the 2018 edition (OECD, 2019), in which boys scored 6 points higher in mathematics than girls. Moreover, one out of every three male students said they would like to work as an engineer or scientist, whereas among girls, this option was only chosen by one out of every five. This difference indicates the existence of a gender gap in both the selection of subjects to study and the choice of future professions linked to STEM (EMAKUNDE, 2021; Martín-Carrasquilla et al., 2022; Reinking & Martín, 2018; Usart et al., 2022; Vázquez & Blanco, 2019).

The different Autonomous Regions in Spain reveal that the gender gap is largest in Andalusia and the Canary and Balearic Islands, and smallest in Asturias, Navarra, Madrid, Galicia and the Basque Country (De la Rica & González, 2013). Indeed, in the Basque Country, the general results of the 2015 Diagnostic Assessment (DA) indicate that girls scored higher than their male counterparts, although in mathematical competence, boys tend to score higher than girls (Angulo et al., 2017).

An increasing number of studies highlight the need to conduct multilevel analyses to consider more systematically the factors in student level (Level 1) and school level (Level 2), thus determining the school effectiveness (Intxausti-Intxausti et al., 2023; ISEI-IVEI, 2024a; Lizasoain-Hernández, 2020; Murillo, 2005; Nachbauer & Kyriakides, 2020). Studies carried out in this field have focused on analysing the effect of variables, such as, achievement, socioeconomic status, ethnicity and gender (Gray et al., 2004; Gustafsson et al., 2018; Kyriakides, 2004; Kyriakides & Creemers, 2018; Kyriakides et al., 2018a, 2018b; Montero-Rojas et al., 2021; Münch & Wieczorek, 2023; Muñoz-Chereau, 2019; Strand, 2010, 2016), recommending that schools provide more support to underprivileged groups in order to compensate for differences in student achievement (Kyriakides et al., 2018b), although they also recognise that part of the responsibility for bridging the gap falls to society and point out that there is still a long way to go in order to achieve true gender equality.

Gray et al. (2004) found that in most schools in the United Kingdom, girls achieve better marks than boys, and that in almost half of them, both genders perform to the same level in their GCSE (General Certificate of Secondary Education) exams. In addition, in a study of mathematics results in Chilean primary schools, Muñoz-Chereau (2019) found that in non-effective schools, girls scored higher than boys, whereas in effective schools, boys scored higher than girls.

Theories which attempt to explain this gender gap often refer to gender socialisation stereotypes and practices (Eccles, 2015; Regner et al., 2014) that serve to strengthen male dominance and female submission (Leaper, 2014), or reinforce the belief that girls are not good at mathematics (Macho-Stadler et al., 2020; Gunderson et al., 2012). Consequently, girls tend to have a more negative attitude toward mathematics than boys, and experience higher levels of anxiety and insecurity, coupled with lack of confidence and perseverance, less curiously and a greater sensation of failure in scientific-mathematical studies (Gil et al., 2006). Other studies argue that support and non-discriminatory attitudes in the peer group may positively impact girls' academic experience and motivation in this field (Carr et al., 2016; Crosnoe et al., 2008; Leaper et al., 2012).

The variability of the results reported at an international, national and regional level indicates that further research is required into different social-cultural contexts (each with its own education system), to determine the origin and true causes of the existing gender gap with a view to design and improve educational policies to promote educational quality for both genders (Kyriakides et al., 2018a; Martín et al., 2020).

In light of the above, the general aim of the present study is to explore whether the gender gap has been overcome in mathematical competence; as well as to check what similarities and differences there are according to the school effectiveness, educational stage and, the DA editions in the ACBC (Spain).

Method

Instruments

ACBC is a region of Spain with two co-official languages (Basque and Spanish), which offers the schools the possibility to choose their vehicular language: the model known as "Model A", in which the vehicular language is Spanish; "Model B", in which part of the subjects are taught in Spanish and the others in Basque; and "Model D" in which the vehicular language is Basque. The Basque Institute for Research and Evaluation in Education (ISEI-IVEI, 2024b) carries out a standardised test similar to PISA, called Diagnostic Assessment (DA). The DA evaluates once every two years ACBC students' mathematical competence and linguistic competence in Spanish and Basque and collects sociodemographic information in 4th grade of Primary (9-10 years old), and 2nd grade of Secondary (13-14 years old). The ISEI-IVEI provided this study with the census database of the DA for the editions 2013, 2015, 2017 and 2019 (2013 was the first edition that the DA was applied online and in 2021, it was not applied due to COVID-19).

Procedure and Analytical Approach

In this quantitative and descriptive study, it has been decided to keep the database separated according to educational stage because not all schools have Primary and Secondary stages.

Multilevel regression analyses (linear mixed models) were conducted (Intxausti-Intxausti et al., 2023; ISEI-IVEI, 2024a; Lizasoain-Hernández, 2020; Münch & Wieczorek, 2023) with mathematical competence as the dependent variable and as independent variables, variables at student level (Level 1) and at school level (Level 2):

- **Level 1**: family´s ESCS (economic, social, and cultural status), student gender (girl or boy), previous performance, retake students (no or yes), immigrant student (no or yes), students speaking Basque at home (no or yes), and educative language model (dummy variable of “Model A”, “Model B” or “Model D”).
- **Level 2**: the system to which the school belonged (public or private), size, ESCS rate, gender rate, previous performance rate, retake students' rate, immigrant student rate, rate of students speaking Basque at home, and rate of the educative language model.

To control for possible collinearity effects, the independent variables statistically significant at $p \leq .01$ were kept in the resulting model. The model was executed again to obtain the predicted values and residuals with the save option.

This provides the residual score (RSD = PRED - FXPRED) to determine the school’s effectiveness in mathematical competence: if the residual score is positive (RSD+), the school is considered effective because they scored higher than expected in comparison with other schools with similar characteristics at Level 1 and 2; and, vice versa, if the residual score is negative (RSD-), the school is considered non-effective because they scored lower than expected in comparison with other schools with similar characteristics at Level 1 and 2.

The regression analysis was then carried out again to test the interaction between the variables: gender and school effectiveness; gender and DA editions; school effectiveness and DA editions; as well as gender, school effectiveness, and DA editions. After verifying the results, it was decided to carry out a comparison of means in order to study the statistically significant differences in depth.

The Mann-Whitney U test was used to compare the mean scores of two groups (such as RSD+ vs RSD- and Girls vs Boys), and the Kruskal-Wallis H test was used to compare the mean scores of more than two groups (for example, RSD subgroups and DA editions), with a small effect size ($r < .10$) in both cases. The decision to conduct non-parametric analyses was because the Kolmogorov-Smirnov test previously performed confirmed that the quantitative data did not follow a normal distribution ($p < .05$).

To determine de RSD subgroups and maintain an equal number of cases (N), a scatter plot was executed to recode the school effectiveness variable in: RSD+ over 10 points; RSD+ between 10 and 5 points; RSD+ between 5 and 0 points; RSD- between 0 and -5 points; RSD- between -5 and -10 points; and RSD- under -10 points.

Sample

This study comprises a census sample of (see Table 1): 772 schools (451 primary schools and 321 secondary schools) and 39407 students (20191 (9754 girls and 10411 boys) from primary and 19216 (9334 girls and 9877 boys) from secondary) in 2013; 781 schools (459 primary and 322 secondary) and 39759 students (20706 (10066 girls and 10582 boys) from primary and 19053 (9157 girls and 9825 boys) from secondary) in 2015; 853 schools (527 primary and 326 secondary) and 42774 students (21338 (10328 girls and 11007 boys) from primary and 21436 (10310 girls and 11121 boys) from secondary) in 2017; and 854 schools (527 primary and 327 secondary) and 41383 students (20762 (9994 girls and 10767 boys) from primary and 20621 (10027 girls and 10594 boys) from secondary) in 2019.

Table 1

Sample of Students by RSD Subgroups of School Effectiveness, Gender, DA Editions and Educational Stage

Mathematical Competence		Students	2013		2015		2017		2019	
			Primary	Secondary	Primary	Secondary	Primary	Secondary	Primary	Secondary
RSD+	over 10	Girls	913	1290	1090	1430	1226	1418	1089	1031
		Boys	900	1287	1150	1521	1219	1443	1167	1046
	from 10 to 5	Girls	1545	1335	1639	1285	1231	1388	1558	1704
		Boys	1585	1359	1690	1330	1325	1402	1630	1667
	from 5 to 0	Girls	2077	1789	1760	1465	2042	2272	1863	2050
		Boys	2189	1793	1807	1647	1934	2274	2081	2216
RSD-	from 0 to -5	Girls	2450	1600	2451	1615	1699	1319	1906	1754
		Boys	2499	1649	2682	1693	1815	1385	2022	1812
	from -5 to -10	Girls	1003	1193	1287	1380	1573	1411	1058	1253
		Boys	1118	1199	1402	1568	1812	1458	1069	1326
	less than -10	Girls	893	1215	1104	1424	1160	1202	1210	1380
		Boys	1047	1333	988	1330	1193	1309	1123	1486

This study complies with the ethical and confidentiality aspects in accordance with the current legislation "Ley Orgánica 3/2018, de 5 de diciembre, de Protección de Datos Personales y garantía de los derechos digitales" (Gobierno de España, 2018); as well as, with the current regulations of the Ethics Committee for Research Involving Human Subjects (CEISH) of the UPV/EHU (2024).

Results

Multilevel regression analyses reveal that the interaction between the variables (gender, school effectiveness and DA editions) is statistically significant, indicating that the gender gap is narrowing with each edition of the DA and that the effectiveness of the schools is increasing at both educational stages:

- **Primary:** gender and school effectiveness ($\beta = 1.334$; $SE\ \beta = .054$; $gl = 71849$; $t = 24.886$; $p < .001$); gender and DA editions ($\beta = -3.146$; $SE\ \beta = .220$; $gl = 71849$; $t = -14.309$; $p < .001$); school effectiveness and DA editions ($\beta = .522$; $SE\ \beta = .020$; $gl = 71849$; $t = 25.960$; $p < .001$); gender, school effectiveness and DA editions ($\beta = -.473$; $SE\ \beta = .036$; $gl = 71849$; $t = -12.984$; $p < .001$).

- **Secondary:** gender and school effectiveness (β = 1.250; SE β = .046; gl = 69576; t = 27.197; $p < .001$); gender and DA editions ($\beta = -.706$; $SE\ \beta = .217$; $gl = 69576$; $t = -3.250$; $p = .001$; school effectiveness and DA editions ($\beta = .478$; $SE\ \beta = .016$; $gl = 69576$; $t = 29.167$; $p < .001$); gender, school effectiveness and DA editions ($\beta = -497$; $SE\ \beta = .030$; $gl = 69576$; $t = -16.611$; $p < .001$).

Comparisons of means indicate that, in general, girls scored lower than boys for mathematical competence (see Table 2). Moreover, the fact that in non-effective schools (RSD-) no statistically significant differences were found among primary students in the 2013 and 2019 DAs or among secondary students in the 2015, 2017 and 2019 DAs suggests that both boys and girls obtained similar results, without attaining the minimum targets set for mathematics. Nevertheless, some positive trends were observed, such as a closing of the gender gap in the 2017 DA in effective secondary schools (RSD+). However, in the 2019 DA, boys' achievement is higher than that of girls in the primary and secondary RSD+ schools.

Table 2

Comparison Between Gender by DA Editions, Educational Stage and School Effectiveness

Mathematical Competence			2013		2015		2017		2019	
			Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
Primary	RSD+	*M*	260.17	263.08	256.36	259.77	254.31	259.11	249.04	254.89
		SD	47.28	51.34	47.66	49.86	46.44	49.96	47.05	51.47
		Z	-2.60		-3.19		-4.42		-5.45	
		p	.009		.001		.000		.000	
	RSD-	*M*	243.28	245.71	238.02	241.95	233.54	238.55	228.45	230.92
		SD	48.86	50.25	45.90	49.21	45.17	48.44	44.92	49.45
		Z	-1.93		-3.27		-4.51		-1.85	
		p	.054		.001		.000		.065	
Secondary	RSD+	*M*	258.20	262.98	254.23	257.70	258.76	259.01	254.98	258.35
		SD	48.36	49.74	46.83	48.17	47.80	50.23	51.65	53.09
		Z	-4.39		-3.36		-.24		-2.65	
		p	.000		.001		.813		.008	
	RSD-	*M*	239.61	242.23	235.99	236.33	238.51	237.67	236.56	238.10
		SD	49.08	49.38	44.65	48.13	45.81	49.35	49.03	51.76
		Z	-2.39		-.271		-.91		-.52	
		p	.017		.786		.364		.604	

Dividing or comparing the sample group in accordance with the six RSD subgroups (see Table 3) provides more detailed information regarding when and in what cases equality or inequality was observed between girls and boys. Where statistically significant differences are observed, they are in favour of boys. Except in these cases where girls scored higher than boys: in non-effective primary and secondary schools with residuals of between -10 or less in 2019 DA; as well as in effective secondary schools with residuals of between 10 and 5 points in 2017 DA. This is in fact, an unusual result that differs from the norm observed to date and a negative trend since it is yet another indication of the gender gap that exists in the ACBC.

Table 3

Comparison Between Gender by DA Editions, Educational Stage and RSD Subgroups of School Effectiveness

Mathematical Competence				**2013**		**2015**		**2017**		**2019**	
				Girls	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**	**Girls**	**Boys**
Primary	RSD+	from ... to 10	*M*	270.54	274.44	266.40	271.90	265.90	271.06	262.68	268.61
			SD	45.79	50.02	48.60	49.66	46.38	50.05	46.60	50.56
			Z	-1.67		-2.68		-2.58		-3.06	
			p	.094		.007		.010		.002	
		from 1 to 5	*M*	261.58	266.87	257.14	259.66	255.91	260.50	249.15	255.11
			SD	47.89	51.35	47.78	49.10	45.15	48.72	46.50	51.05
			Z	-2.83		-1.26		-2.29		-3.21	
			p	.005		.209		.022		.001	
		from 5 to 0	*M*	254.56	255.72	249.08	252.13	246.18	250.51	240.76	246.85
			SD	46.64	50.74	45.66	49.18	45.72	49.10	45.88	50.66
			Z	-.56		-1.79		-2.63		-3.58	
			p	.576		.074		.009		.000	
	RSD-	from 0 to -5	*M*	249.31	251.73	241.89	248.51	237.73	244.88	234.30	238.97
			SD	48.75	50.91	45.97	49.05	45.54	48.30	45.90	49.55
			Z	-1.55		-4.46		-4.23		-3.02	
			p	.122		.000		.000		.003	
		from -5 to -10	*M*	238.57	240.40	236.94	236.00	233.94	238.78	225.11	228.55
			SD	48.42	49.24	46.68	48.61	44.58	47.77	42.39	48.88
			Z	-.675		-.79		-2.53		-1.13	
			p	.499		.432		.011		.258	
		from -10 to …	*M*	232.01	236.95	230.70	232.60	226.83	228.50	222.16	218.58
			SD	47.07	47.75	43.87	47.94	44.70	48.04	44.41	47.01
			Z	-1.97		-.35		-.53		-2.22	
			p	.049		.728		.596		.027	
Secondary	RSD+	from ... to 10	*M*	267.32	272.09	261.80	267.41	266.90	267.81	268.77	271.68
			SD	47.05	48.64	46.19	47.86	47.33	50.02	50.59	53.38
			Z	-2.41		-3.12		-.93		-1.15	
			p	.016		.002		.352		.251	
		from 10 to 5	*M*	257.74	262.94	254.09	253.08	263.38	259.08	253.23	257.99
			SD	48.17	49.38	46.69	48.86	47.70	48.81	51.30	52.99
			Z	-2.80		-.33		-2.39		-2.25	
			p	.005		.744		.017		.025	
		from 5 to 0	*M*	251.90	256.44	246.96	252.49	250.76	253.20	249.42	252.30
			SD	48.43	49.79	46.46	46.53	46.93	50.43	51.25	51.90
			Z	-2.52		-3.21		-1.21		-1.62	
			p	.012		.001		.225		.106	
	RSD-	from 0 to -5	*M*	249.75	253.13	240.86	241.02	245.43	244.78	241.54	245.62
			SD	49.53	47.27	44.93	48.41	47.27	49.47	49.38	51.53
			Z	-2.10		-.40		-.39		-2.13	
			p	.036		.692		.705		.033	
		from -5 to -10	*M*	237.39	239.70	238.71	237.75	238.16	238.11	235.31	239.35
			SD	47.17	49.10	45.87	48.55	44.75	48.70	50.49	52.48
			Z	-.91		-.81		-.27		-1.30	
			p	.365		.420		.788		.195	
		from -10 to …	*M*	228.24	230.59	227.76	228.62	231.40	229.64	231.34	227.80
			SD	47.57	49.35	41.91	46.32	44.35	48.80	46.55	49.67
			Z	-1.00		-.12		-1.02		-263	
			p	.317		.907		.309		.009	

As shown in Tables 4 and 5, statistically significant differences were also observed between students of the same gender.

Table 4

Comparison Between School Effectiveness by DA Editions, Educational Stage and Gender

Mathematical Competence			2013		2015		2017		2019	
			RSD+	RSD-	RSD+	RSD-	RSD+	RSD-	RSD+	RSD-
Primary	Girls	*M*	260.17	243.28	256.36	238.02	254.31	233.54	249.04	228.45
		SD	47.28	48.86	47.66	45.91	46.44	45.17	47.05	44.92
		Z	-16.26		-18.00		-20.20		-19.99	
		p	.000		.000		.000		.000	
	Boys	*M*	263.10	245.71	259.77	241.95	259.11	238.55	254.89	230.92
		SD	51.36	50.25	49.86	49.21	49.96	48.44	51.47	49.45
		Z	-16.02		-17.18		-19.21		-21.35	
		p	.000		.000		.000		.000	
Secondary	Girls	*M*	258.20	239.61	254.23	235.99	258.76	238.51	254.98	236.56
		SD	48.36	49.08	46.84	44.65	47.80	45.81	51.65	49.03
		Z	-16.86		-17.69		-19.52		-16.77	
		p	.000		.000		.000		.000	
	Boys	*M*	265.98	242.23	257.70	236.33	259.01	237.67	258.35	238.10
		SD	49.73	49.38	48.17	48.12	50.23	49.35	53.09	51.76
		Z	-18.41		-20.56		-19.49		-18.21	
		p	.000		.000		.000		.000	

Students enrolled in non-effective schools scored lower than those enrolled in effective schools, thereby indicating that there is still much work to be done.

Table 5

Comparison Between RSD Subgroups of School Effectiveness by Educational Stage, DA Editions and Gender

Mathematical Competence				RSD+			RSD-	
				from ... to 10	from 10 to 5	from 5 to 0	from 0 to -5	from -5 to -10	from -10 to …
Primary	2013	Girls	*M*	270.54	261.58	254.56	249.31	238.57	232.01
			SD	45.79	47.89	46.65	48.76	48.42	47.07
			X^2	425.14					
			p	.000					
		Boys	*M*	274.44	266.88	255.72	251.73	240.40	236.95
			SD	50.02	51.35	50.74	50.92	49.24	47.75
			X^2	425.99					
			p	.000					
	2015	Girls	*M*	266.40	257.14	249.08	241.89	236.94	230.70
			SD	48.60	47.78	45.66	45.97	46.68	43.87
			X^2	440.58					
			p	.000					
		Boys	*M*	271.90	259.66	252.13	248.51	236.00	232.60
			SD	49.66	49.10	49.18	49.05	48.61	47.94
			X^2	493.72					
			p	.000					

	2017	Girls	*M*	265.90	255.91	246.18	237.73	233.94	226.83
			SD	46.38	45.15	45.72	45.54	44.58	44.70
			X^2			563.58			
			p			.000			
		Boys	*M*	271.06	260.50	250.50	244.88	238.78	228.50
			SD	50.05	48.72	49.10	48.31	47.77	48.04
			X^2			559.83			
			p			.000			
	2019	Girls	*M*	262.68	249.15	240.76	234.30	225.11	222.16
			SD	46.60	46.50	45.88	45.90	42.39	44.41
			X^2			587.81			
			p			.000			
		Boys	*M*	268.61	255.11	246.85	238.99	228.55	218.58
			SD	50.56	51.05	50.66	49.55	48.88	47.01
			X^2			693.96			
			p			.000			
Secondary	2013	Girls	*M*	267.32	257.74	251.90	249.75	237.39	228.24
			SD	47.05	48.17	48.43	49.53	47.17	47.57
			X^2			475.65			
			p			.000			
		Boys	*M*	272.09	262.94.	256.44	253.13	239.70	230.59
			SD	48.64	49.38	49.79	47.27	49.10	49.35
			X^2			544.42			
			p			.000			
	2015	Girls	*M*	261.80	254.08	246.96	240.86	238.71	227.76
			SD	46.19	46.69	46.46	44.93	45.87	41.91
			X^2			451.47			
			p			.000			
		Boys	*M*	267.41	253.08	252.49	241.02	237.75	228.62
			SD	47.86	48.86	46.53	48.41	48.55	46.32
			X^2			550.07			
			p			.000			
	2017	Girls	*M*	266.90	263.38	250.76	245.43	238.16	231.40
			SD	47.33	47.69	46.93	47.27	44.75	44.35
			X^2			536.67			
			p			.000			
		Boys	*M*	267.81	259.08	253.20	244.78	238.11	229.64
			SD	50.02	48.81	50.43	49.47	48.70	48.80
			X^2			506.05			
			p			.000			
	2019	Girls	*M*	268.77	253.23	249.42	241.54	235.31	231.34
			SD	50.59	51.30	51.25	49.38	50.49	46.55
			X^2			408.09			
			p			.000			
		Boys	*M*	271.68	257.99	252.30	245.62	239.35	227.80
			SD	53.38	52.99	51.90	51.53	52.48	49.67
			X^2			506.99			
			p			.000			

A comparison of the scores obtained in the different DA editions (see Table 6) revealed that, scores decreased over time among primary students, whereas among secondary students, scores dropped from 2013 to 2015, but then increased or recovered somewhat in 2017 and, the scores dropped again in 2019.

Table 6

Comparison Between DA Editions by Educational Stage, School Effectiveness and Gender

Mathematical Competence				2013	2015	2017	2019	X^2	*p*
Primary	RSD+	Girls	*M*	260.17	256.36	254.31	249.04	111.92	.000
			SD	47.28	47.66	46.44	47.05		
		Boys	*M*	263.08	259.77	259.11	254.89	49.77	.000
			SD	51.34	49.86	49.96	51.47		
	RSD-	Girls	*M*	243.28	238.02	233.54	228.45	212.41	.000
			SD	48.86	45.90	45.17	44.92		
		Boys	*M*	245.72	241.95	238.55	230.92	187.51	.000
			SD	50.25	49.21	48.44	49.45		
Secondary	RSD+	Girls	*M*	258.20	254.23	258.76	254.98	33.24	.000
			SD	48.36	46.84	47.80	51.65		
		Boys	*M*	262.98	257.71	259.01	258.35	34.39	.000
			SD	49.74	48.17	50.23	53.09		
	RSD-	Girls	*M*	239.61	235.99	238.51	236.56	17.92	.000
			SD	49.08	44.66	45.81	49.03		
		Boys	*M*	242.24	236.33	237.67	238.52	41.82	.000
			SD	49.38	48.13	49.35	49.73		

Conclusion

In short, the results of this study confirm that the gender gap in mathematical competence of students in the ACBC has not yet been overcome. Achievement is determined by both gender (in favour of boys) and school effectiveness (in favour of RSD+ schools). Even so, some positive trends can be observed in the latest editions of the DA and, above all, in the secondary education stage to close the gender gap.

The Organisation for Economic Cooperation and Development (OECD, 2012, 2019) states that equality in education will be achieved when everyone, regardless of their personal or social circumstances (such as gender, ethnic origin or family context) can reach at least a minimum basic level of competence. This suggests that quality may be linked to gender equality, since both girls and boys achieved good results in mathematics, exceeding the minimum targets, in those effective schools in the ACBC. However, these results or targets were not achieved in a uniform manner, since, in general, boys scored higher than girls, indicating that the gender gap remains latent and has not yet been fully overcome (Angulo et al., 2017; Correa, 2016; Fuentes & Renobell, 2020; Ibañez & Formichela, 2017; López et al., 2021; Nosek et al., 2009; Quiroz et al., 2020; Riegle-Crumb, 2005). This result is reflected in the choice of studies and in the jobs that girls and boys opt for (EMAKUNDE, 2021; Martín-Carrasquilla et al., 2022; Reinking & Martín, 2018; Usart et al., 2022; Vázquez & Blanco, 2019): women are more likely to choose the social sciences, arts and humanities; while men are more likely to choose science, technology and engineering.

On some occasions, the opposite trend has even been observed, with girls scoring better than boys (Gray et al., 2004; Muñoz-Chereau, 2019), and this cannot be considered positive as it is yet another example of the existing gender gap in the ACBC.

The equalitarian results obtained in the 2017 DA edition in secondary effective schools may be linked to the implementation of the "1st Master Plan for Co-education and Prevention of Gender-based Violence in the Basque Education System 2013-2017" (Gobierno Vasco, 2014). This plan encompasses 150 public and 50 semi-private schools, along with 10 schools with comprehensive co-education projects. Moreover, the fact that this trend was not observed in primary effective schools may be due to the fact that, more secondary than primary school teachers participated in training on gender equality, as reflected in the "2nd Co-education Plan for the Basque Education System, on the road to equality and positive treatment, 2019-2023" (Gobierno Vasco, 2019a). This result corresponds to the latest TIMSS report (IEA, 2020), which shows a smaller gender gap in 8th grade (secondary) compared to 4th grade (primary) among the participating countries.

One conclusion that can be drawn from the results of the present study is that, as indeed pointed out by Kyriakides et al. (2018a), it is important to generate mechanisms that measure equality in schools in a systematic manner, with the aim of providing comprehensive feedback to schools and teachers alike, in order to help them develop strategies and action plans that address specific elements of co-education and gender equality in the classroom.

It is also necessary to adopt the action proposals established by the *Real Sociedad Matemática Española* (RSME - Royal Mathematical Society of Spain) for the teaching of mathematics in primary and secondary school (Martín et al., 2020). These proposals can be summed up as follows: design textbooks and teaching resources to help teachers foster scientific vocations among female students and counteract stereotypes; improve initial life-long learning training plans for mathematics teachers and specifically for training teachers to overcome the gender gap in the classroom; focus on mathematics training that fosters reasoning, rationale and the development of traditional mathematics more centred around problem-solving, while at the same time incorporating connections between mathematics and other disciplines through project-based learning; teaching currently-relevant and future-oriented subjects linked to topics such as robotics, programming and machine-tooling, etc., fostering new educational models in mathematics (such as, for example, programmes such as ESTALMAT that stimulate early talent in mathematics and the Mathematics Olympics); increase economic and human resources and decrease the teacher-student ratio in the classroom; and close the gap between science and humanities, among others.

European Schoolnet (2017) has also published a series of recommendations and projects to help schools generate interest and engage students, teachers and other stakeholders in the development of STEM competences. In June 2018, the STEAM Euskadi strategy was established in the Basque Country (Gobierno Vasco, 2021). This strategy aims to: 1) foster scientific-technical education and training in all educational stages, involving social-economic stakeholders in this undertaking; 2) inspire professional vocations and aspirations in the STEM field, paying special attention to female students in order to adequately prepare them to face the challenges of the future; and 3) foster scientific-technological dissemination and culture among Basque citizens. It is a relatively new strategy in which more attention should be paid to gathering evidence regarding the pros and cons, as indeed highlighted by other studies (Acar et al., 2018; Han et al., 2015; Martín-Carrasquilla et al., 2022; Ortiz-Revilla et al., 2021; Usart et al., 2022).

Several studies (Else-Quest et al., 2010; Martín et al., 2020; Muñoz-Chereau, 2019; Strand, 2010, 2016) have also pointed out that although schools play an important role in reducing achievement gaps between girls and boys, those responsible for designing education policy must also address this problem, taking both internal and external school factors into account (Carr et al., 2016; Crosnoe et al., 2008; Eccles, 2015; Gil et al., 2006; Gunderson et al., 2012; Leaper, 2014; Leaper et al, 2012; Macho-Stadler et al., 2020; Montero-Rojas et al., 2021; Regner et al., 2014), along with the negative cultural values, motivational patterns and gender stereotypes conveyed, for example, by the media, which may prompt girls to feel less confident, regardless of their innate mathematical ability (Muñoz-Chereau, 2019).

Future studies should continue to analyse whether the gender gap has been overcome in subsequent editions of the DA, both in mathematics and in other competencies (Intxausti-Intxausti et al., 2023). It would also be interesting to explore through a qualitative approach how effective (Caldwell & Harris, 2008) and equal schools (i.e., schools that perform above expectations and have also overcome the gender gap) carry out coeducational and equalitarian practices. This can provide further information to identify factors that may explain the gender differences found in this study to improve teacher training programmes (McKinsey & Company, 2007), and local policies to promote quality education for both genders.

Acknowledgments

We would like to acknowledge the Basque Institute for Research and Evaluation in Education (ISEI-IVEI) for providing the supporting data for this study.

This research has been carried out within the R&D Project [PGC2018-094124-B-I00] "GESKOLA - School improvement from a gender perspective in schools in the Autonomous Community of the Basque Country (ACBC)" financed by the State Research Agency (AEI) of the Ministry of Science, Innovation and Universities (MCIU) of the Spanish Government and co-financed by the European Regional Development Fund (ERDF); and, within the GANDERE Research Group [GIU21/056] subsidized by the University of the Basque Country (UPV/EHU): https://www.ehu.eus/gandere

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