

THE EFFECT OF SINGLE-SEX EDUCATION ON MOTIVATION. EVIDENCE OF A RANDOMIZED EXPERIMENT IN SECONDARY EDUCATION

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This paper examines the effect of single-sex education on student's motivation. To estimate the impact of boys only, girls only and mixed education, we ran an experiment in a large Flemish school. By randomizing 13 to 14 years old students to homogenous and heterogeneous gender groups, we observed in a quantitative analysis that the gender composition significantly influences the motivation of students. In comparison to the boys only group, girls only and mixed gender groups experienced a significantly lower motivation due to the group composition. The impact on motivation deteriorates with the number of girls. The quantitative findings are confirmed by observational evidence from a qualitative assessment.

Keywords: Gender; Motivation; Secondary education; Boys education; Mixed education.

1. Introduction

The results of the international comparative PISA test (Programme for International Student Assessment) by the OECD, which tests 15 year-old students in terms of their skills in reading, mathematics and natural sciences, show significant gender-specific discrepancies. In most cases boys have significantly worse results than girls.

The social transformation of gender roles - ostensibly due to the emancipation of women as an ideological stumbling block for men - led to uncertainties in the behaviour of boys and men, and was partly the reason that gender education increasingly has been and will be given more importance in the discussion on educational science. In the Anglo-American world, the debate about "sex" and "gender" has a longer tradition. In the late 1990s this debate spilled over to Europe, where it can be stated that this linguistic differentiation has been an essential and vital constituent in the professional discussion and perception of this phenomenon. After the demand for coeducational training and upbringing was met decades ago in most European countries, a new gender-specific or gender-equitable questioning of differentiated aspects came back into focus in the last few years. This is reflected in family, curricular and extracurricular institutions as well as for example in the political debate. Gender education is particularly concerned with the typical role behavior of girls and boys and examines these in psychological and sociological terms, in order to derive from its findings possibilities and consequences for educational practice. Various scientific studies show that gender education has become a subject of extensive research. Their results deliver new insights into the behavior and the ratio of boys and girls.

Gender in Flanders

If one compares the situation of gender-specific action in educational institutions with other countries, it can be stated as rather remarkable that only since 1995/96 there are coeducational classes as required by law in Flanders. Nevertheless, until today one can find in many institutions still traces of the former girls or boys schools. This gender-related history is also reflected in the fields of study offered at secondary schools such as nursing of children or car mechanics.

The quality of the education provided in Flanders is regarded generally as very high. However, many studies have pointed out the important differences between girls and boys. Where still in the 1970s of

the 20th Century, the lower academic performance of girls gave cause for concern, there came a shift in the 1990s towards boys, and the onset of the described situation could clearly also be transferred to Flanders.

Serious concerns arise in terms of school performance, lagging in the learning process, many school dropouts without qualifications of boys, lack of order and discipline, as well as the absenteeism in the classroom. It should be emphasized that this is not a typical Flemish (Belgian) problem. Even in international literature, the so-called “boy problem” is a recurrent theme.

2. Monoeducational or coeducational classes

This raises the question of how the teaching in monoeducational (single-sex education) or coeducational classes is advantageous or which disadvantages can be found therein. This question has taken on new importance in the educational debate for some time. No later than with the results of comparative studies such as TIMSS and PISA, and the finding that there are significant performance differences in boys and girls, this question is being discussed again. Bossen et al. (2013) clarify with their analysis that “the research position on the effects of mono- and coeducation is so far inconclusive”. The authors refer to the two possible forms of co-education: the full version on the one hand and the temporarily separate classes on the other. In their argumentation, they also refer to studies from New Zealand and Flanders, where it was established that there are no advantages to monoeducation. Ruessel states also in this context that the “advocates of monoeducation argue that boys and girls have different needs and that they are very different in the way they learn. They refer to data showing that both boys and girls are under challenged in mixed classes.” Proponents of coeducation, however, think that “mixed classes are more in line with the moral code of modern Western society (...) and they can adapt much better” (Ruessel 2007).

The literature shows a consistent picture in terms of the advantages and disadvantages of both forms of education. Riordan (1990) shows in a comprehensive literature review the arguments for and against mixed- and single-sex schooling.

Park, Behram and Choi (2013) examined in a randomized experiment the causal effects of single-sex schools on college entrance and college exams. They observed that single sex schools produce a higher percentage of graduates, even after controlling for observed heterogeneity. Similar observations have been made by: Nagengast, Marsh and Hau (2013). Using a matching analysis they observed little evidence for positive effects of single-sex education on the outcomes in the final two years of high school. On the contrary, using the variation in single-sex education originating from an assignment algorithm, Jackson (2012) observed that most students do not perform better in single-sex schools. Also Van de Gaer et al. (2004) and Harker (2000) observed similar findings.

While the aforementioned papers focused on school outcomes, Sullivan, Joshi and Leonard (2010) examined the effects of single-sex education in the long run. They observed in terms of education attainments that single sex schooling is positive for girls at age 16, but neutral for boys, while both genders attain qualification in more gender-atypical subject areas due to single-sex education. The influence of monoeducation has also been studied with respect to choices for particular study programs. For example Cherney and Campbell (2011) observed that students from single-sex schools have more participation in physical sciences.

Overall, this brief literature review indicates that the composition of the class group might influence both the education attainments, as well as study choices. In the next subsection, we examine the effect of monoeducation on student’s motivation.

3. Identification strategy

To examine the impact of boys only, girls only and mixed education, we ran an experiment in a large Flemish school. The experiment allows us to examine whether the didactical procedures have a different effect on homogenous gender groups, than on heterogeneous gender groups. Using an experimental identification strategy, we estimated differences in motivation between boys, girls and mixed groups. We focused on pupils aged 13 till 14 years old. Before the experiment took place (i.e., during regular education), these students were grouped in 5 mixed classes of, on average, 20 students. The experiment involved one full day of teaching in the experimental setting.

Random assignment

We randomly assigned students to (1) a boys only group, (2) a girls only group, and (3) two mixed groups. A first mixed group had exactly the same number of girls as boys, while a second mixed group had more boys than girls. The descriptive statistics in Table 1 indicate that besides for gender, the groups were perfectly equal on all observable characteristics, including average school exam scores. We could therefore assume that also on the unobservable characteristics (e.g., income of the parents, socio-economic status) the groups were equal in expectation.

Timing and tests

The experimental day took place as follows. In the first 15 minutes of the day, all students received some general information about the day. They were told that they would follow a “COMENIUS day” (after the European COMENIUS funding) in which they received didactical information made by partners in various European countries (including UK, Turkey, Austria, Norway and Poland). The students were not informed about the experimental setting, nor about the true purpose of the day. At the end of the 15 minutes, they were regrouped in the new groups according to the group assignment by the researchers. Next, each group of students went to a particular class where they received during one hour information on sexuality, interculturality or lifestyle. After a short break of 30 minutes, the students went to a different teacher. By having the same teacher teach the same content (to different groups) during the whole day, we avoided a bias in the outcomes due to differences in teaching style. At the end of each class, students filled out a motivation questionnaire (See Appendix). The scale reliability coefficient (cronbach’s alpha) for the questionnaire is 0.86, which indicates a high internal consistency. Besides these quantitative assessments, there was also an observer present in the class who made a qualitative analysis of the differences between the student groups. Same as the teacher, the observer followed four times the same subject. The focus of the qualitative assessment was put on the attitude of students during the course, the classroom management, class dynamics and peer-effects.

Course content

As the experiment took only 1 day, we tried to maximize its impact by focusing on gender specific issues. Thanks to this course content, we were able to estimate an upper bound impact of the gender homogeneous groups. The content of the courses can be found on:

<http://www.education-and-gender.eu/edge/index.php/en/ects-en>.

4. Results

Descriptive statistics

The descriptive statistics are presented in Table 1. Group 0 denotes the boys only group, group 1 and 2 are the mixed groups, while group 3 is the girls only group. In group 1 there were more boys, while group 2 had an almost equal percentage of boys and girls. We received from the school information on the average grade on school exams. Thanks to the randomization, there were no significant differences

between the four groups on this ability measure. Students were also effectively reshuffled among the original class groups.

Table 1: Descriptive statistics

Group	Variable	n	Mean	St.dev
0 = boys group	gender (boy = 0)	168	0	0
	Regular class	168	1.29	1.18
	Average exam score	161	70.88	7.91
1 = mixed group	gender (boy = 0)	154	0.41	0.49
	Regular class	154	1.82	1.37
	Average exam score	154	69.74	17.28
2 = mixed group	gender (boy = 0)	161	0.48	0.5
	Regular class	161	1.65	1.28
	Average exam score	147	71.83	6.26
3 = girls group	gender (boy = 0)	154	1	0
	Regular class	154	2	1.32
	Average exam score	147	73.82	7.82

Regression specification

To control for observed heterogeneity in the sample, we estimated the following regression:

$$Y_i = \beta_0 + \beta_1 \text{group}_i + \beta X_i + \varepsilon_i \quad (1)$$

Y denotes the post test on motivation of student i . It should be noted that thanks to the randomization the prior motivation of the students was equal across all groups. β_0 is a constant, group indicates whether the student i was assigned to the boys only group (reference group), a mixed group with more boys (group 1), a mixed group with the same number of boys and girls (group 2) or to a girls only group (group 3). X is a vector of observed characteristics of the students and ε_i is an i.i.d. error term with mean 0 and a constant variance. Thanks to the random assignment of the students to the groups, we could interpret the estimated correlation of treatment with Y as a causal effect. The coefficient of the group variable is the variable of interest. In what follows below we only present this estimation.

Various alternative specifications of equation (1) were estimated. A first model specification estimated the effect of participation to the experiment. It does not include any variables to capture the heterogeneity among students. A second model specification added control variables to Model 1. In particular, we added a subject fixed effect: two subjects were focussing on “identity”, while two other subjects focussed on “sexuality”. Model specification 3 further adds the average grade on the school exam to the regression. This allowed us to control the ability of the student. In model 4 we added postcode fixed effects to capture potential heterogeneity arising from peer effects in the neighbourhood the child was living in. Finally, to account for the fact that some students might know each other from their original (traditional) class, we included class fixed effects. These captured the heterogeneity arising from the original peer group.

Effect of gender groups on motivation

We examined the effects of homogenous versus heterogeneous gender groups on motivation of students. By running the five model specifications, and by gradually adding the fixed effects, we could test the robustness of the results. The outcome variable is the average on the 9 motivation questions. The results, as presented in Table 2, reveal that the motivation of the students decreased with the number of girls present in the group. In comparison to the boys only group (i.e. the reference group),

all groups experienced a significantly lower motivation due to group composition. The decreasing coefficient reveals that this effect deteriorates with the number of girls. This outcome was observed even after controlling the test subject, postcode and class fixed effects.

Table 2: Regression outcomes of motivation (outcome variable is the average of the 9 questions)

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Constant	4.4191319***	4.3735285***	4.7468128***	4.7009537***	4.6455948***
Group 1 (mixed)	-.25652575***	-.25557568***	-.25710873***	-.25746396***	-.31951179***
Group 2 (mixed)	-.48045235***	-.48070912***	-.46902214***	-.42290295***	-.43958223***
Group 3 (girls)	-.98166539***	-.98644011***	-.95213613***	-.93260749***	-.987885***
Subject fixed effect		YES	YES	YES	YES
Grade school exam			YES	YES	YES
Postcode fixed effects				YES	YES
Class fixed effects					YES
N	334	334	324	324	324
R ² -adjusted	0.27698207	0.28824644	0.28437095	0.30022517	0.31736162

where *, ** and *** denote significance at 1, 5 and 10 % respectively

As the dependent variable in Table 2 is an average, it might hide some heterogeneity. Table 3 avoids this bias by presenting the results for each question separately. The pattern of the results largely corresponds to the results in Table 2. However, some differences emerge. If the majority of the class group members are boys, the pupils did not see any difference in the teaching style of the teacher (question 3), the extent that they liked the course (question 1) and the collaboration among the class group members (question 7). In none of the groups, did we observe a significant difference in the disagreements among the pupils (question 8).

Overall, the results for motivation indicate that the composition of the class group has a significant influence on the motivation of the students. Boys only groups have a higher motivation than mixed and girls only groups.

Table 3. Regression outcomes of motivation on the separate questionnaire items

Question	Model 1	Model 2	Model 3	Model 4	Model 5
1. I liked the past course					
Group 1 (mixed)	-0.22678917	-0.21951244	-0.2145102	-0.1308308	-0.17969097
Group 2 (mixed)	-1.2654255***	-1.2410485***	-1.2222195***	-1.0518714***	-1.0795682***
Group 3 (girls)	-1.3858801***	-1.3786034***	-1.3387102***	-1.1881298***	-1.2328675***
2. I feel good in this new class group					
Group 1 (mixed)	-.53606719***	-.53754036***	-.5197864***	-.47046107***	-.60700106***
Group 2 (mixed)	-.65246769***	-.6530251***	-.56764046***	-.47011677***	-.51060631***
Group 3 (girls)	-1.3219064***	-1.3190356***	-1.2746908***	-1.1977658***	-1.3268625***
3. I thought the teacher could handle the class group well.					
Group 1 (mixed)	-0.09897361	-0.09426286	-0.09825119	-0.08427897	-0.16275812
Group 2 (mixed)	-.36617262**	-.36540872***	-.3355441**	-.30955657**	-.33583091**
Group 3 (girls)	-1.1513978***	-1.1642111***	-1.1300803***	-1.136727***	-1.2029558***
4. I tried to perform well during last class because it is important.					
Group 1 (mixed)	-.33448617**	-.33448617**	-.33858905**	-.35065686**	-.46848644***
Group 2 (mixed)	-.71562867***	-.71706976***	-.69647321***	-.60011625***	-.64550219***

Group 3 (girls)	-1.557971***	-1.5648069***	-1.5046007***	-1.4470164***	-1.5532385***
5. I tried to perform well during last class because the teacher expected this from me.					
Group 1 (mixed)	-.31998517**	-.31967313**	-.28580873*	-0.20534273	-.30203544*
Group 2 (mixed)	-.95480965***	-.95473104***	-.92287289***	-.76268194***	-.8168401***
Group 3 (girls)	-1.2961125***	-1.2975544***	-1.2237564***	-1.1341891***	-1.2149247***
6. I tried to perform well during last class because I liked the class group.					
Group 1 (mixed)	-.41642229***	-.41618391***	-.43174616***	-.4586659***	-.55528407***
Group 2 (mixed)	-.61069377***	-.61035416***	-.60926823***	-.52503918***	-.55304455***
Group 3 (girls)	-1.4164223***	-1.4168557***	-1.374642***	-1.3026551***	-1.3882432***
7. I can work well together with the other students in the class.					
Group 1 (mixed)	-0.26356305	-0.25399332	-0.26545282	-0.24697114	-0.20211366
Group 2 (mixed)	-.56669573**	-.56514388**	-.58651226**	-.51679022**	-.48044805*
Group 3 (girls)	-1.2125724***	-1.2410362***	-1.2272694***	-1.1849103***	-1.1270947***
8. During last class there were various disagreements (e.g. discussions or quarrels) disturbing the class.					
Group 1 (mixed)	0.07331378	0.06267031	0.04230703	0.04488233	-0.0134448
Group 2 (mixed)	.64210985**	.64038388**	.56562444**	.49851788*	0.45728623
Group 3 (girls)	0.44044665	.47210417*	.49262363*	0.40290533	0.33945722
9. In my opinion, the other students collaborated well during the class.					
Group 1 (mixed)	-.32795699*	-.32086576*	-.31037619*	-.41079982**	-.41840234**
Group 2 (mixed)	-1.2063354***	-1.2051854***	-1.1811367***	-1.2654359***	-1.2355884***
Group 3 (girls)	-1.7894955***	-1.8105873***	-1.7913432***	-1.8712938***	-1.8789361***

Qualitative analysis

The results of the quantitative analysis are confirmed by the qualitative analysis. The observers in the back of the class observed that the girls group asked less questions, was more quiet, collaborated less, and was more silent during class than the mixed and the boys groups. In general, the more girls in the class group, the more “relaxed” the group became. It was observed that the teacher had to make a significantly higher effort to convince the girls groups to participate. The observations are summarized in Table 3.

Table 4. Qualitative analysis by the observer

Boys only	Girls only	Equally divided	More boys
Class management			
‘Under control’	Calm	Very good	Very good
Requires more discipline from the teacher	At the end, the teacher has to ask the students not to talk to each other	During the group work, the pupils collaborate well	Less structure
Throw with pencils			Teacher says two times ‘do not talk to each other’
A lot of noise			
Attitude of the students during the course			
Very vivid	Sweet	Boys give a lot of answers, girls do not participate	Boys and girls give answers
Very enthusiastic	Few answers	Motivated	
Everybody wants to present	Not responding		
Students bully the teacher by using a laser pointer			

Dynamics during the class			
Very active, positive	Slow (due to the group, not to the teacher)	Excellent	Excellent (but more noise after 40 minutes)
Very tiring for the teacher			
Are there students hiding or asking a lot of attention?			
Everybody is actively involved in the class	All girls hide	4 boys are very active	Nobody is hiding

5. Conclusion

This article examined through a randomized experiment the effect of homogenous and heterogeneous gender groups on motivation. It was observed that boys only groups outperform the girls groups in terms of motivation. Both on motivation in general, and on particular questions, they have a higher motivation than an only girls and mixed groups.

This article provides various lines for further research. First, it would be interesting to examine the effects of homogenous gender education on educational attainments. Moreover, it would be interesting to add different age cohorts and subjects to the analysis.

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Appendix

Motivation questionnaire

All questions are on a 6 point Likert scale, where 1 corresponds with "Totally disagree" and 6 to "totally agree".

1. I liked the past course
2. I feel good in this new class group
3. I thought the teacher could handle the class group well.
4. I tried to perform well during last class because it is important.
5. I tried to perform well during last class because the teacher expect this from me.
6. I tried to perform well during last class because I liked the class group.
7. I can work well together with the other students in the class.
8. During last class there were various disagreements (e.g. discussions or quarrels) disturbing the class.
9. In my opinion, the other students collaborated well during the class.