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Pupils' Mathematics Achievements: Is There a Difference When Taught By a Female Teacher or a Male Teacher?

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Abstract

Inclusive and high-quality education must provide equal opportunities for all pupils to learn leaving no child behind. Different studies show that secondary education is an area where boys are disadvantaged and also that young people, especially girls, are not enthusiastic about learning the exact sciences at school. There are many and various factors (individual personal, social, and cultural, school context) that determine pupil gender differences in mathematics achievements. Recognizing the impact of all these factors on pupil learning and achievement, this research focuses on clarifying how mathematics achievements of pupils (girls and boys) are related to the activities of teachers of different genders (female or male). The research includes data on 47581 learners and their 594 mathematics teachers, who were selected from forms 5-10 (basic school) and forms I-IV (secondary school) in 179 Lithuanian schools during the period 2012-2021. The results of the study suggest that in the surveyed sample of Lithuanian schools the majority of teachers teaching mathematics are women and the achievements of girls in mathematics are higher than those of boys in all primary and secondary school classes, except for classes 5 and 7. However, the differences in the work of female and male teachers are very small and the achievements of pupils (girls and boys) in mathematics are not related to gender-determined activity characteristics of teachers. The presented regression model of mathematics achievement of pupils (girls and boys) hardly differs from the actual results, which means that all the presented coefficients of the characteristics of the teacher's work affect the work of teachers (irrespective of their gender) and, accordingly, the pupils' mathematics achievements.

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1. Introduction

The goals of the 2030 Agenda for Sustainable Development aim to ensure the most favourable educational conditions for all schoolchildren and to ensure that no one is left behind (UN System CEB, 2017). To ensure inclusive and equitable quality education for all pupils and to promote their lifelong learning opportunities, attention is also focused on the learning outcomes of girls and boys and the factors that affect them. The Executive Summary "Leave No Child Behind: The Global Report on Boys' Disengagement from Education" announced by UNESCO in 2022 provides an overview of qualitative and quantitative data from more than 140 countries, which shows that in most countries boys are at increased risk than girls of repeating classes, failing to complete various levels of education and achieving poorer school performance (UNESCO, 2022). A tendency is observed that secondary education is where disadvantage of boys is most prevalent. On the other hand, the study ROSE ("The Relevance of Science Education") (Sjøberg, Schreiner, 2019) published in 2019 shows that young people, particularly girls, are not enthusiastic about learning the exact sciences at school. Therefore, it is important to analyse the process of girls' learning the study subjects of STEAM (science, technology, engineering, the arts, and mathematics).

Numerous research studies indicate that girls learn better at school compared to boys (Ullah, Ullah, 2019; Workman, Heyder, 2020; Alghamdi et al., 2020) and it is also obvious that women prevail in teaching profession (Fulard, 2020). According to Holmlund and Sund (Holmlund, Sund 2008), theoretically such a possible causal relationship (higher results for girls due to a higher number of female teachers) can be explained employing two hypotheses. Firstly, teachers may be more favourable to pupils who are more similar to themselves and, consequently, evaluate them better. Secondly, teachers can be role models for schoolchildren, so having a teacher of the same gender can also affect pupil effort as well as their performance. However, these researchers also acknowledge (Holmlund, Sund, 2008) that the results of the research cannot provide a clear answer to whether there is a causal relationship between the same gender teacher and pupil achievement because it may be affected by various factors (pupil age and abilities, differences in the selection of teachers for various subjects, peculiarities of dividing pupils into classes, etc.).

Nevertheless, studies reveal that the same-gender teachers may serve as better role models for their pupils (Farland-Smith, 2014). Thus, more female STEM (science, technology, engineering, and mathematics) teachers are needed (Dulce-Salcedo et al., 2022). Löwe and colleagues (Löwe et al., 2022) claim that the gender of the teacher is an important factor and girls respond more strongly than boys to the same-gender role models. Their research results show that girls, who are taught by a female teacher of mathematics in class 10, are significantly more likely to choose mathematics as an advanced course in a secondary school compared to their peers taught by a male teacher. The results obtained during the research conducted by Lim and Meer (Lim, Meer, 2020) disclose a similar tendency that a female teacher of mathematics in class 7 increases the likelihood that schoolgirls will attend a STEM-focused secondary school, take advanced mathematics courses, and pursue a degree in STEM.

Following the results of their research, Andersen and Reimer (Andersen, Reimer, 2019) state that assigning pupils to the same-gender teacher significantly improved pupil achievement. Moreover, when Korean secondary schoolchildren were randomly assigned to classes, girls performed significantly better on standardized tests when taught by female teachers, while this effect was moderate on male students (Lim, Meer, 2017). However, results from other researcher show the opposite. For example, Krämer and colleagues (Krämer et al., 2016) point out that a member of the opposite gender in education is useful for girls. Their performance and effort are significantly better when they interact with a teacher of the opposite gender who were responsive. Other researchers (Winters et al., 2013) do not identify any statistically significant correlation between assignment of the same-gender teacher and pupil achievements in mathematics and or reading at primary school but they point out such statistically significant relationships at a secondary school or higher, although their impact (the teacher's gender and pupil achievements) is moderate. Bottia, Stearns, Mickelson, Moller and Valentinoc (Bottia et al., 2015) claim that the proportion of female mathematics and science teachers at school has no impact on schoolboys but has a significant effect on girls' learning and future studies in STEM programmes.

Although, as mentioned earlier, few girls are interested in studying science, technology, engineering or mathematics (Bottia et al., 2015), researchers also conduct surveys on the study process of girls in terms of the lecturer's gender (female or male). According to Price (Price, 2010), female students are less likely to remain students when more STEM courses are taught by female lecturers. The data of other researchers (Canaan, Mouganie, 2021) reveal that if a scientific advisor in the first year of studies at college is a woman and not a man, the girls are significantly more likely to enrol in and complete STEM studies. And although the gender match between teachers and schoolchildren usually does not affect the choice of major and courses, it can be seen that students receive better marks in courses, which are taught by the same gender lecturers in the fields, which are traditionally dominated by the representatives of the opposite gender, for example, STEM (Griffith, 2014).

Another very important aspect to be mentioned when analysing the relationship between pupils' achievements in mathematics and the gender of the teacher is the age of the learner. Around the age of 11-13, schoolgirls begin to understand and apply gender stereotypes and at this developmental period, according to Ambady, Shih and Kim (Ambady et al., 2001), differences in mathematics performance between girls and boys begin to emerge, and mathematics begins to be considered the domain of the latter. The studies of other researchers (Galton et al., 2003) also disclose that schoolchildren's attitude towards mathematics becomes more negative after transition from the primary to the secondary school. A tendency emerges that girls under 11 years old like mathematics more than boys but at the age of 15 the situation changes and the girls point out that they like this study subject less (Bevan, 2001; Prendergast, O'Donoghue, 2014). The transition from elementary to secondary mathematics appears to be a potential time when schoolchildren, especially girls, develop more negative attitudes towards mathematics. Therefore, particular attention should be paid to identifying educational policies and practices that help mitigate the emergence of negative attitudes towards mathematics at this critical stage of children education.

It is clear that the factors that determine the gender differences in mathematics achievement of pupils are numerous and diverse. Following Cascella, Giberti and Bolondi (Cascella et al., 2020), they can be referred to as individual personal factors (e.g. biological differences), social and cultural, as well as school context-related factors, for example, syllabus, teaching practice in the classroom, methods of assessment (Leder, Forgasz, 2008). Finally, it appears that male and female teachers perceive and evaluate schoolboys and schoolgirls differently (Andersen, Reimer, 2019). Recognizing the influence of all these factors on the learning process of schoolchildren, in this article focuses on pupils' mathematics achievements as the object of research and aims to explain how mathematics achievements girls and boys are related to the activities of the teacher (female or male).

2. Methodology

The total sample of research data. The records of Lithuanian schools in the electronic diary information system "ManoDienynas" (translation "My Diary") and covering the academic years from 2012 to 2021 were chosen for the presented research. Such information allows for identifying the class, the study subject and schoolchildren that learn it and associating the teacher with a study subject and a certain class. The data in the electronic diary are continuously collected, so it is possible to compare the activities of teachers and the progress of pupils in learning. The data of the diary also allows identifying demographic characteristics of teachers and schoolchildren (gender and age).

The target sample of the research. The target database was formed that included schoolchildren who received marks in mathematics in the academic years from 2012 to 2021. The analysis did not include the learners, who were in the system but did not receive any marks. Thus, in total 47581 learners and 594 mathematics teachers working with them, were selected from classes 5-10 (basic school) and classes I-IV (secondary school) from 179 Lithuanian schools.

Missing data are rare but they were identified in the compiled base. The records, where the gender of the teacher was unfamiliar, were excluded from the database together with all the related information, i.e., the data on the school, class and study subject. Thus, 1.9 % of records were deleted and more than 4.1 million records remained in the filtered database. The detailed information on the analysed data is presented below (Table 1).

Table 1. The number of records analysed in the school years from 2012 to 2021

School year	Homework Create	Late ForClass	Marks	Message	Missed lessons
2012/13	9527871	81325	5882139	2666466	2351160
2013/14	9673692	80120	5800506	3329226	2364990
2014/15	12781272	75100	5681527	4016788	2310040
2015/16	20864641	77335	5464680	6414585	2096165
2016/17	20736730	74820	4859699	6727092	2341115
2017/18	23482960	78420	6362220	6613208	2494505
2018/19	26431623	84192	6439815	7307495	2410915
2019/20	32413130	64086	6432300	14316630	1646755
2020/21	34615110	84246	8098260	14876944	1003275

Notes:
LateForClass – being late for school
Marks – all the marks presented in the electronic diary
Message – a text message in the electronic diary (comments and complements)
Missed lessons – lessons missed by schoolchildren
HomeworkCreate – homework assignments presented in the electronic diary by the teacher

The research ethics. It is noteworthy that the basic principles of research ethics were followed during the research. The researchers received depersonalised data of electronic diary, which means that there was no access to specific data of schools or individual persons (teachers, pupils, parents) such as names, surnames or other indicators that refer to the identity of institutions or persons were not available. Before conducting the research, new unique numbers for each teacher, pupil or parent were randomly generated in the database to identify the data.

Methods. Following *researchers* (Winters et al., 2013; Hwang, Fitzpatrick, 2021) we used pupil fixed effects and ran separate analytic model by gender to investigate the links between pupil–teacher gender matching and pupil achievement. To analyse the effect of teacher-pupil gender interaction, estimate the following linear regression equation was estimated:

$$Mean\_mark_{ptgy}=\beta0+\beta1(Pupil\_Gender_{ptgy}) + \beta2className_{ptgy}+ \beta3\ Number\ of\ pupil's\ actions_{ptgy} + Nmarks_{ptgy} + \beta5Mean(Simple)_{\ ptgy} + \beta6Mean(Test)_{ptgy} + \beta7Mean(Independ)_{ptgy} + \beta8N\_good\_message_{ptgy} + \beta9\ N\_bad\_message_{ptgy}+ \beta10\ L\_attendance_{ptgy}+ \beta11\ Number\ of\ teacher's\ actions_{ptgy} +qt(1)$$

Meanings of abbreviations used in the equation:

- $Mean\_mark_{pmgt}$ is the study success (achievement) of pupil *p*, assigned to teacher *m* at school class (classes: 5,6,7,8, 9(I),10(II), III, IV) *g*, in year *t*.
- β0—intercept in the equation.
- $Pupil\_Gender_p$ indicates the pupils' *p* gender (girl = 1, boy = 2). This model was calculated separately by teacher gender.
- β1 indicates the impact to which pupils of a definite gender learn better when they are assigned to a female teacher or to a male teacher.
- $Class\_Name_{pmg(t-n)}$ –the class *g* of the pupil *p*, assigned to teacher *m*, in year *(t-n)*.
- β2 indicates pupil's class effects.
- Number of pupil's $actions_{pmg(t-n)}$ – number of pupil's *p* actions to teacher *m*, at school class *g*, in year *(t-n)*.
- β3 – indicates the effect of the number of actions in the e-diary on study success.
- $N\_marks_{pmg(t-n)}$ – number of marks which was received by pupil *p*, assigned to teacher *m*, at school class *g*, in year *(t-n)*.
- β4 – indicates the effect of the number of marks in the e-diary on the final study success.
- $Mean(class\ work)_{pmg(t-n)}$ – average mark of classwork and homework of the pupil *p*, assigned to teacher *m,* at school class *g,* in year *(t-n)*.
- β5 indicates the effect of the average mark of classwork and homework on the study success.
- $Mean(independent\ work)_{\ pmg(t-n)}$ – average mark of independent work of pupil *p*, assigned to teacher *m,* at school class *g,* in year *(t-n)*.

- β6 indicates the impact of the average mark of independent work on the study success.
- Mean(test work) $_{pmg(t-n)}$ – average test mark for pupil *p*, assigned to teacher *m,* at school class *g,* in year *(t-n)*.
- β7 indicates the impact of the average mark for tests on the final study success.
- N_good_message $_{pmg(t-n)}$ – number of text message of positive character received by the pupil p or pupil's parent from the teacher m, at school class g, in year (t-n).
- β8 – Indicates the impact of the number of positive text message on the study success.
- N_bad_message $_{pmg(t-n)}$ – number of text message of negative character received by the pupil p from the teacher m, at school class g, in year (t-n).
- β9 – Indicates the impact of number of text message of negative character on the study success.
- L_attendance $_{pmg(t-n)}$ – pupil's p attendance to the class to teacher m, at school class g, in year (t-n).
- β10 – indicates the impact of pupil attendance on his/her final study success.
- Number of teacher's actions $_{pmg(t-n)}$ – the number of actions of the teacher m (neutral text messages to the pupil m and the pupil's m parents, assigned tasks, number of file downloads) to the pupil p, at school class g, in year (t-n).
- β 11 – indicates the impact of teacher's m actions on the final study success.
- qt – random error of regression model in year t.

In order to increase the accuracy of the model and reduce the error due to the different dimensionality of the indicators, all data were normalized before presentation (Min-max normalization was applied).

3. Results

Firstly, before seeking to understand how mathematics achievements of pupils (girls and boys) are related to the (female or male) teacher's activities, the general job characteristics of female teachers in Lithuanian schools were analysed. The results of the research are presented in Figure 1.

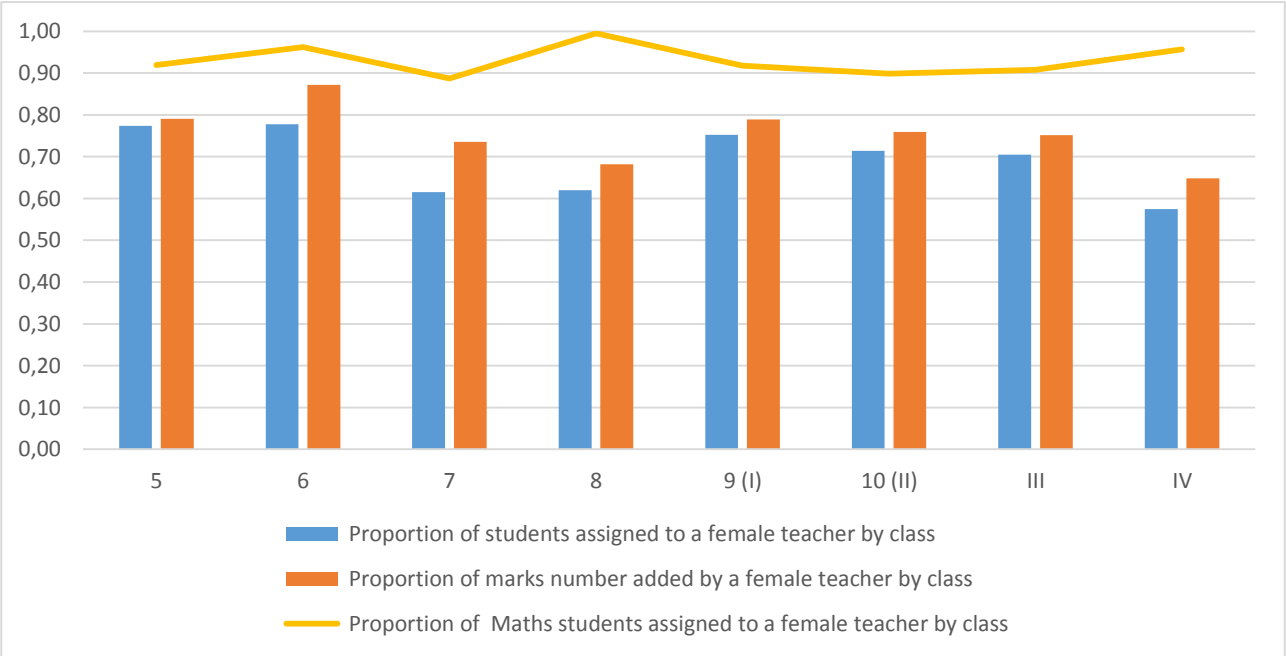


Fig. 1. General characteristics of female teacher of different subjects

The obtained research data allow stating that female teachers prevail in teaching of all study subjects in a Lithuanian school. Most of them work in junior classes (5 and 6), respectively, 77 % and the 78 %, and fewest female teachers are observed in classes 7 and 8 (respectively, 62 % in each) and in the most senior class of a secondary school (class IV) – 57 %. The same regularity can

be observed in the number of marks received by pupils. The highest number of marks is written by women teachers in the first classes of a basic school, i.e., 79 % in class 5 and 87 % in class 6, and the least number of marks is written in class IV (65 %). The analysis of data related to mathematics showed that this study subject is taught almost only by women in all classes. For example, 92 % of pupils in class 5, 96 % of pupils in class 6, 99 % in class 8 and 96 % of pupils in class IV are taught by female teachers of mathematics.

The results received after the analysis of pupils' achievements in mathematics (Figure 2) revealed that higher marks are characteristic of younger schoolchildren (classes 5-8), whereas marks in senior classes (9(I), 10(II), III and IV) are lower among both boys and girls. Girls do best in mathematics in classes 5 and 6, whereas boys receive best marks in classes 5 and 7. It should be noted that boys demonstrate the lowest marks in class 10 (II). It can also be seen that in the sample of Lithuanian pupils, mathematics achievements among girls are higher than those of boys, except in classes 5 and 7.

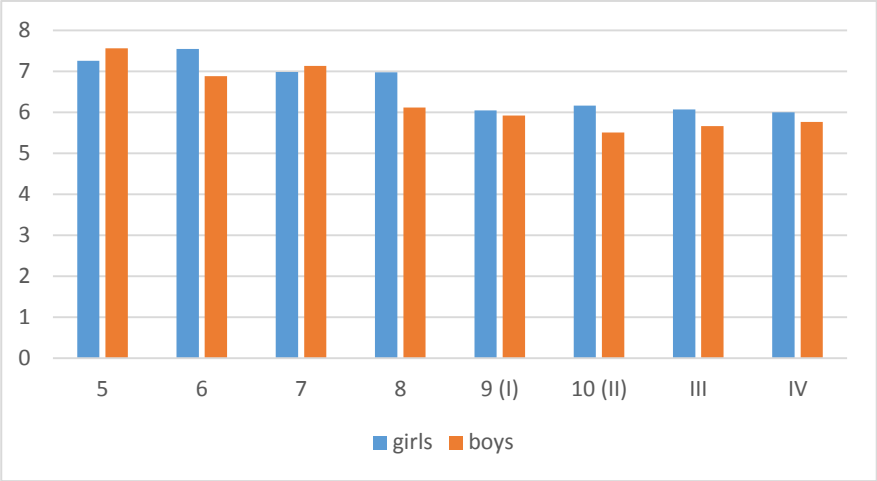


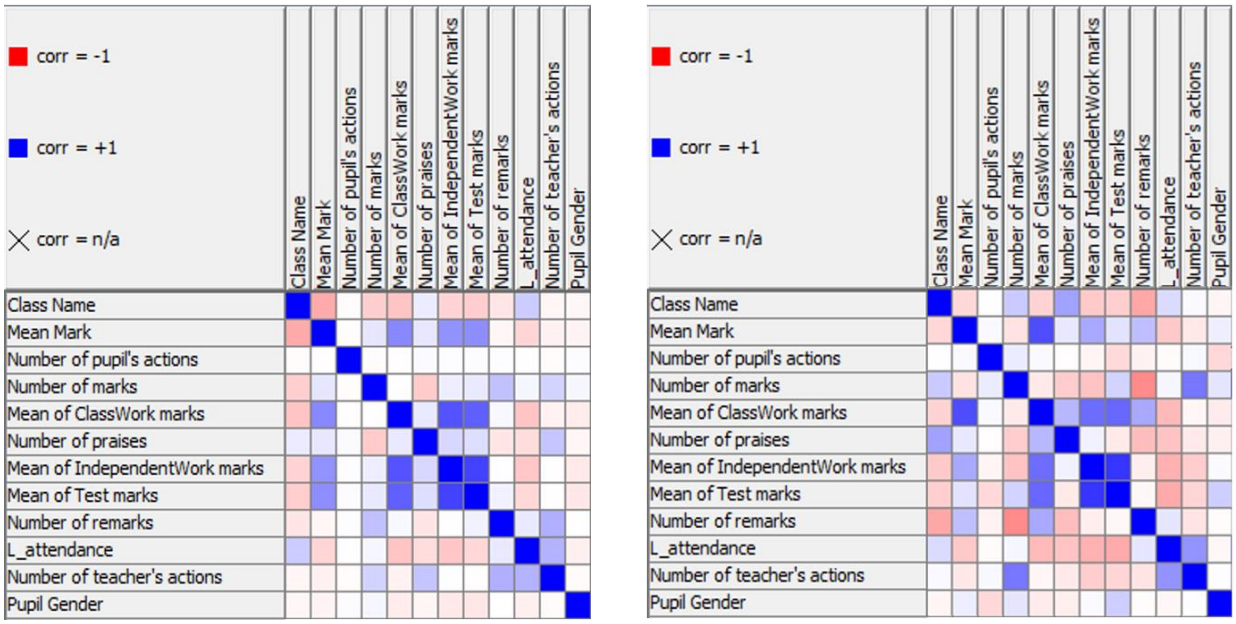
Fig. 2. Comparison of pupils' achievements in mathematics (girls and boys)

Correlation analysis was also carried out focusing on relationships between various work characteristics of mathematics teachers (woman and men) (e.g., number of marks, number of praises, number of negative remarks, mean of marks, etc.), which can have influence on the study success of pupils. The obtained research results are available in Figure 3.

The obtained research results allow stating that the more senior the class, the lower is the mean mark in mathematics received from teachers of both genders. The received correlation relationships are negative and their values are -0.308 (taught by female teachers) and -0.301 (taught by male teachers). It was also found that in senior classes, female and male teachers of both genders write more remarks to schoolchildren, but the number of marks varies. As can be seen from the results of the correlation analysis, female teachers write fewer marks in the senior classes (coefficient value -0.291), while a different tendency is observed among male teachers, as they tend to write more marks (coefficient value -0.132).

The total mean of pupils' marks correlates with the daily received mark in mathematics (the values of correlation coefficient are equal to 0.534 (female teachers) and 0.415 (male teachers), also with test marks (respectively – 0.322 (female teachers) and 0.44 (male teachers) and marks of independent work (respectively – 0.281 (female teachers) and 0.434 (male teachers). It should be noted that pupils' marks of independent work very strongly correlate with their test marks. The value of the correlation coefficient of these variables is equal to 0.654 when taught by female teachers and to 0.786 when taught by male teachers. This proves that improving marks of pupils' independent work result in better test marks. Analysing the statistically significant work characteristics of teachers of different genders, it was established that in the senior classes, teachers of both genders write fewer marks for independent work, but women write them statistically significantly less frequently than men ($p = 0.013$). There is also a significant difference in the correlations between the number of good messages written by male and female teachers and the

mean of pupils' independent work marks (p = 0.048). Weaker correlation was received between the increasing number of praises in the e-diary and higher marks for independent work was identified when taught by female teachers compared to male teachers. The same tendency was observed while searching for correlation between the test marks and negative remarks. Statistically significant difference was observed between teachers of different genders (p = 0.001). Weaker correlation relationship was received regarding the statement that the increasing number of negative remarks may lead to lower test marks when taught by female teachers compared to male teachers.



Female teachers Male teachers

Fig. 3. Correlation relationships of various work characteristics comparing mathematics teachers (female teachers and male teachers)

Table 2. The impact of different factors of both gender teachers on pupils' learning success in the regression model

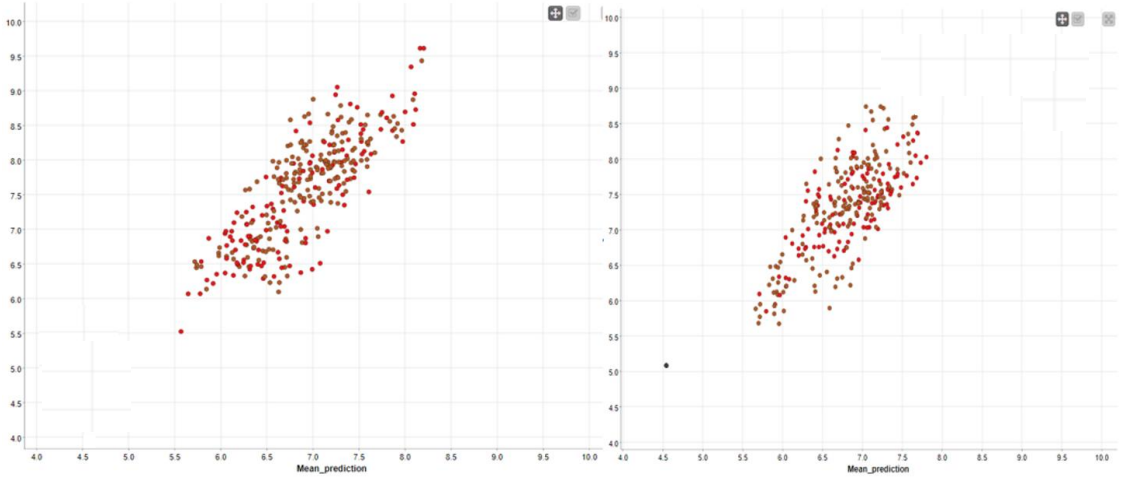
	Girls		Boys	
	Teachers (women)	Teachers (men)	Teachers (women)	Teachers (men)
Class Name	-0.213	-0.068	-0.213	-0.107
Number of pupil's actions	0.013	0.309	0.006	0.128
Nmarks	0.229	-0.2174	0	0.25
Mean(Simple)	0.679	0.69	0.02286	0.13
N_good_message	0.263	-0.114	0.068	0.14
Mean(Test)	0.474	-0.151	0.047	-0.149
Mean(Independent)	0.817	-0.261	0.082	0.01
N_bad_message	0.012	0.352	0.052	0
L_attendance	0.0054	-0.0228	0.005	0.04
Number of teacher's actions	-0.023	0.0179	0.002	-0.05
Pupil_gender	0.118	0.1804	0.037	0.179

Finally, a regression model of pupils' mathematics achievements (girls and boys) was designed. Table 2 provides the main findings of the regression model described in the equation (in the methodological part of the article).

Thus, boys tend to learn much better when taught by a male teacher. However, the extent of the impact of male teachers is not great and ranges from 0.01 to 0.019 standard deviation. Moreover, male teachers have greater influence on study success of boys and girls (although the difference is not significant). At the same time, women teachers have bigger influence on girls and almost no impact on boys taught by women is observed.

Comparison of behaviour between schoolboys and schoolgirls reveals insignificant differences. The coefficients of activity in the electronic diary of pupils of different genders taught by female teachers are as follows: 0.014 SD of girls compared to 0.018 SD of boys. Teaching pupils of both genders, the coefficient of activity in the e-diary of female teachers is 0.02 SD compared to that of 0.034 SD of male teachers.

The accuracy of the designed model was also validated. While designing the model, the database was divided into two parts: teaching (80 %) and testing (20 %). A validation sample was used to create the comparison between the predicted pupil marks and the actual marks presented in Figure 4.



Girls math_prediction Boys math_prediction

Fig. 4. Comparison between the predicted marks of pupils and their actual marks (brown colour – forecast, red – actual, real data)

It should be noted that the results presented in Figure 4 are grouped by classes. The mean value of pupil's mark was taken as a normalised value, therefore, the model output is not an accurate reflection of the mean of marks but a normalised value. Exceptional values (non-typical pupils) were also filtered out.

The prediction accuracy equals 96.2 % and the mean error is 0.398. Such research results imply high reliability. Table 3 contains the characteristics of the accuracy of the model.

Table 3. The characteristics of the model accuracy

	Girls	Boys
R^2	0.038	0.033
mean absolute error	0.398	0.383
mean squared error	0.318	0.178
root mean squared error	0.364	0.322
mean signed difference	-0.075	-0.075

4. Discussion

The results obtained from the study suggest some differences between the work of female and male teachers in mathematics. In senior classes, male teachers write more marks compared to female teachers. Moreover, there is a higher probability that when taught by male teachers, the increasing number of praises in the e-diary will lead to higher marks for independent works and the increasing

number of negative comments in the e-diary will result in a drop in test marks. However, the identified differences in the work of teachers of opposite genders are minor, and the obtained results disclose that mathematics achievements of different gender pupils (boys and girls) are not related to activities of teachers in terms of their gender (female and male). This confirms the data of other researchers that there is no single answer to the question of whether there exists a causative relationship between the gender of a teacher and pupil achievements (Holmlund, Sund, 2008).

Our findings also reject the prevailing stereotype that boys do better in mathematics than girls. In the surveyed sample of Lithuanian pupils most teachers teaching mathematics are women and the achievements of girls in mathematics are higher than those of boys in all primary and secondary school classes, except for classes 5 and 7. In fact, many studies have found no gender differences in solving various simple mathematics problems, such as addition and subtraction or quantitative comparison of numbers (Hutchison et al., 2019). According to researchers (Duckworth, Seligman, 2006; Hyde et al., 2008), girls typically get higher marks than boys in mathematics lessons and take the same or even more complex tests in line with school curricula, such as state-standard mathematics tests. Some studies show that girls get better marks in mathematics than boys because the former are more self-disciplined when it comes to completing various school tasks (Duckworth, Seligman, 2006). Perhaps this diligence on the part of the girls can help them get good marks and perform well on curriculum-based tests. Consequently, both parents and teachers can help children be more successful in mathematics lessons by encouraging both boys and girls to do mathematics problems consistently and honestly both at home and in the classroom. With the success of the tasks performed, children's engagement and interest in mathematics increases, which leads to successful learning of mathematics.

On the other hand, it should be admitted that there are also studies that show higher achievements in mathematics among boys. For example, Geary et al. (Geary et al., 2021) state that the better mathematics achievements of boys are predetermined by their visual spatial abilities. Namely, in mathematics, the superior visual-spatial skills of the boys compensate for lower levels of their classroom engagement. Spatial imagination/visualization skills are plastic and have been shown to be related to spatial games (for example, building blocks for young children, various kinds of visual-spatial games for elder children). It is observed that boys play such games more frequently than girls (Terlecki, Newcombe, 2005; Cherney, London, 2006). Therefore, encouraging all children to play spatial games or to participate in various activities that involve spatial rotation of objects could facilitate the development of better mathematical abilities of girls and boys. Bleske-Rechek, Browne (2014), Miller, Halpern (2014) also point out that boys perform better at high-level/more complex standardized tests such as SAT, ACT and GRE, which assess mathematical skills that are less closely related to what is taught in the classroom. However, it should be noted that the differences in the results of the mathematics test between girls and boys are small and appear to decrease even more (Wai et al., 2010; Miller, Halpern, 2014). The gender gap in mathematics is decreasing in countries with a culture of gender equality (Guiso et al., 2008). Obviously, certain stereotypes limit girls' choices to learn, e.g., the research conducted by Carlana (2019) showed that teachers with more implicit gender stereotypes about girls' ability to do mathematics tasks advise them to choose less math-intensive subjects and girls taught by such teachers tend to show lower level of self-confidence. Thus, abandoning stereotypes should be one of the objectives of teachers.

Finally, the regression model for mathematics achievement of pupils (girls and boys) almost coincides with the actual results, which shows that all the coefficients of teacher work characteristics included into the formula have impact on teachers' work (irrespective of gender) and on mathematics achievements of pupils. It should be noted that the impact of teacher gender is low and ranges from 0.01 to 0.019 of standard deviation. It evidences that organisation of the learning process rather than the teacher's gender contributes to pupil achievements, that is, various characteristics of teacher work show which actions of teachers have influence on the learning success of pupils.

5. Conclusion

The results of the study suggest that in the surveyed sample of Lithuanian schools the majority of teachers teaching mathematics are women and the achievements of girls in mathematics are higher than those of boys in all primary and secondary school classes, except for classes 5 and 7. However, the differences in the work of female and male teachers are very small and the achievements of pupils (girls and boys) in mathematics are not related to gender-

determined activity characteristics of teachers. The presented regression model of mathematics achievement of pupils (girls and boys) hardly differs from the actual results, which means that all the presented coefficients of the characteristics of the teacher's work affect the work of teachers (irrespective of their gender) and, accordingly, the pupils' mathematics achievements.

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