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Differences in elementary school achievement between girls and boys: Does the teacher gender play a role?

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Abstract Elementary schools in many countries record an unequal representation of male and female teachers with female teachers in huge majority. At the same time, numerous studies reveal that girls generally outmatch boys in the majority of school subjects. Consequently, possible effects of teacher–pupil gender interaction are becoming an important topic in studies on pupils' school achievement. The aim of the present study was to examine the proposed teacher–pupil gender interaction effect on pupils' school achievement in Croatian elementary schools. The nationwide sample of pupils and their teachers from all 844 Croatian elementary schools was used. There were 48,232 pupils at the age 10 and 46,196 pupils at the age 14 in the research. Two types of pupils' school achievement measures were assessed—school marks and standardized knowledge tests for almost all subjects in school curriculum. Results indicate that girls generally outmatch boys by school marks, whereas results are equivocal when standardized tests were used. The teachers' gender effect measured by knowledge of their pupils reveal the superiority of female teachers, but only on standardized achievement tests. The interaction effects of teachers' and pupils' gender on school achievement are generally insignificant. The stability of these results was confirmed in both age cohorts and assumption that differences in boys' and girls' school achievement are related to teachers' gender cannot be supported within Croatian elementary education.

Keywords School achievement · Elementary school · Student–teacher gender interaction · School marks · National testing

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Pupil's gender is proved to be an important factor in explaining various educational outcomes. Various studies have documented differences in school achievement between girls and boys, and numerous authors have offered theoretical explanations. Observed gender differences were attributed to biological and genetic determinants (Spinath et al. 2008; Hicks et al. 2008), variations in the abilities and competencies (Buzhigeeva 2004; Deary et al. 2007), disparities in personality characteristics (Steinmayr and Spinath 2008; De Fruyt et al. 2008), differences in the type and level of motivation (Preckel et al. 2006; Meece et al. 2006), distinct attitudes toward school (Buzhigeeva 2004), different social experiences (Abraham 1989; Lahelma 2005) and social expectations (Meelissen and Luyten 2008; Hyde et al. 1990), disparities in self-discipline and self-regulation (Duckworth and Seligman 2006; Matthews et al. 2009), and differences in preferred learning styles (Carrier 2009).

A particularly intriguing explanation of gender differences in pupils' school achievement is related to the dynamics of pupils-teacher gender interaction, or more specifically, to teachers' and pupils' gender combination. Moreover, in recent years, teacher–pupil gender interaction effect has become a hot topic in educational research and policy. The reason for the great interest on this subject is related to the following two facts:

First, overwhelming dominance of female teachers in elementary and secondary schools in most educational systems worldwide. Moreover, certain studies on teachers' gender effect on their work performance stress that female teachers were generally more successful in teaching than their male counterparts, especially if the knowledge of their students' was measured by standardized tests. Studies conducted by UNESCO showed that children taught by female teachers tend to have better school results than children taught by male teachers (UNESCO 2000, 2005). They were described as more compassionate, patient, gentle, and open for questions and discussion. Simpson and Erickson (1983) and Stake and Katz (1982) also support those findings, and suggest that female teachers give more verbal and nonverbal approvals to pupils than male teachers.

The second fact is that nowadays, girls tend to be more successful than their boys during elementary and early secondary education, even in math and science that are traditionally considered to be "masculine subjects" (e.g., Holmlund and Sund 2008; Mills et al. 2004). The finding that girls have better school achievement than boys in various school subjects is supported by a number of other studies (e.g., Demie 2001; Gibb et al. 2008; Duckworth and Seligman 2006; Ciarrochi et al. 2007; Leeson et al. 2008; Steinmayr and Spinath 2008).

Observing these two educational realities, some researchers have related these trends to the lack of male teachers as role models for boys (Skelton 2003). They suggest that male teachers would encourage boys to make more effort in school activities. Indeed, some researchers have found that student–teacher gender combination does have some effect on pupils' school achievement. Dee (2006) confirmed that female pupils have better school achievement when taught by women, and male pupils perform better when they are taught by men. Ammermüller and Dolton (2006) reached similar results based on data from British and American elementary schools. The authors concluded that teachers' gender plays an important role in the success of pupils in higher grades, when male teachers tend to improve the achievement of boys in science and mathematics. However, these results were inconsistent with numerous other studies which did not show the relevance of pupil–teacher gender interaction on pupils' achievement (Francis et al. 2008; Carrington et al. 2007; Driessen 2007; Marsh et al. 2008).

These ambiguous findings could be partly attributed to different outcome measures provided by different studies. Some studies have assessed pupils' attitudes and opinions (Skelton 2003; Francis et al. 2008), a few were focused on pupils' motivation and engagement (Marsh et al. 2008), whereas others were interested in social interaction and the quality of teacher–pupil relationship (Hutchings et al. 2008; Duffy et al. 2001; Carrington et al.

2007). A small number of researchers focused on pupil performance measured by school marks or standardized tests as indicators of school achievement (Driessen 2007; Dee 2006). Furthermore, most researchers directed their attention to only a few school subjects, in particular mathematics and language, which largely limited their conclusions. In addition, some studies have problems related to methods of collecting data, such as interviews, opinion surveys, and observations.

Finally, if we focus only on studies where pupils' subject knowledge was measured, the type of this measure can blur the results. If we look at school marks, girls are consistently better than boys, but this is not so if we use standardized knowledge tests (Hicks et al. 2008). For example, on standardized tests, including Advanced Placement Test, parts of the Scholastic Aptitude Test and college admission tests, girls do not outperform boys sustainably (Davis 2007). The nature of school marks is essentially different from the characteristics of standardized tests. School marks partly indicate non-cognitive factors such as following the teachers' instructions, obeying the rules, conformity, and neatness, which favor girls (Carrier 2009). Girls are better adapted to learning activities, less school anxious (Buzhigeeva 2004), have a more positive attitude toward school (Resing et al. 1999), have higher self-discipline (Duckworth and Seligman 2006), more effective self-regulation (Matthews et al. 2009), and less tendency to avoid work (Steinmayr and Spinath 2008). All of this gives an advantage to girls in traditional school setting and enables them to obtain higher school marks than boys.

This research was carried out on a huge sample of Croatian elementary school pupils, and our aim was to comprehensively examine educational achievement differences that can be attributed to pupils and teachers gender. Our central focus was on the possible interaction effect of teacher–pupil gender combination on pupils' school achievement. In order to reinforce our findings, we have considered the variation in measures of educational outcomes and developmental differences that can occur during elementary education. We have used a large number of school subjects in order to provide an overall insight in school knowledge. As indicators of school achievement, we have used both school marks and standardized test scores to avoid gender bias in educational outcome measures. Furthermore, we have investigated differences in school achievement between girls and boys at different stages of primary education. We have included two age cohorts of elementary school pupils: the pupils at the end of fourth grade (age 10), and the pupils at the end of the eight grade (age 14). Thus, we were able to examine if the results are stable and equally pronounced during primary education.

Method

Participants

Participants were pupils from all 844 elementary schools in Croatia. The first subsample consisted of pupils at the end of first phase of elementary school (fourth grade; age 10–11), and the second subsample consisted of pupils at the end of their elementary education (eighth grade, age 14–15). A total of 48,232 pupils were in the younger sample and a total of 46,196 pupils were in the older sample. The fourth grade sample included 23,702 girls (49.14%), whereas the eighth grade sample consisted of 22,472 girls (48.64%). The percentage of pupils taught by male teacher by each school subject ranged from 6.0% to 6.9% in the fourth grade, and from 6.3% to 45.0% in the eighth grade. In the fourth grade, pupils had the same teacher for all school subjects during the first 4 years of schooling. In the eighth grade, students had the same teacher in the Croatian language, the English language, History and Geography for a period of 4 years (5th to 8th grade). Physics, Chemistry, and Biology

were introduced as new subjects in the seventh grade, and the same teacher taught these subjects for a period of 2 years. Teacher substitutions over these periods (grades 1–4 and grades 7–8) are exceptional (longer sick-leaves, maternity leaves, job changes, etc.), and in most cases pupils are exposed to the same teachers during longer educational periods. The data on substitute teachers during the observed educational period were not collected.

Measures

The data used in this study were collected as a part of national examination in Croatian primary schools, during which school achievement in majority of subjects covered by the curriculum for respective grades was examined. In the fourth grade, achievement was measured in the following subjects: the Croatian language, the English language (as a foreign language), Mathematics, and Nature and Society.[1] In the eighth grade, achievement was measured in the following subjects: the Croatian language, the English language (as a foreign language), Physics, Chemistry, Biology, Geography, and History.

School achievement was operationalized by two types of indicators. The first type was final school marks from respective curriculum subjects. School marks are awarded by teachers and are based on the continuous assessment of student coursework and homework, their participation in class, as well as their performance in various assignments and examinations during their school year. In Croatian educational system, final school marks for individual curriculum subjects range from 1 (inadequate) to 5 (excellent).

In addition to school marks, students' results on objective tests assessing learning outcomes in respective curriculum subjects were used as indicators of achievement. The tests examined students' knowledge and competences in a particular subject at the end of a school year. The raw results on these tests were transformed and expressed as percentage of points achieved on each test, ranging from 0% to 100%.

All tests used in this study had good psychometric properties. They proved to be discriminative, objective and valid measures of student achievement in the observed school subjects used in national testing in Croatian elementary schools (Burušić et al. 2008a, b; Babarović et al. 2009; Burušić et al. 2009). Cronbach's alphas as indicators of tests' reliability vary from 0.64 to 0.89 in younger sample, and from 0.64 to 0.87 in older sample. All tests have a clear one-factor structure, with almost all items highly saturated by first principal component. The correlation between subjects' marks and test results vary from 0.53 to 0.61 in younger, and from 0.40 to 0.68 in older sample.

Apart from achievement measures, the data on pupils' gender and particular subject teachers' gender were also collected. These data were collected from Croatian digital database of all primary schools and pupils (*e-matica*), and verified in communication with each school's administration.

Procedure

Pupils' school achievement measured by standardized tests was assessed during national testing in Croatian elementary schools. The testing was carried out in class, following a highly controlled and uniform procedure during February 2008. The testing was conducted at the beginning of the second semester in the fourth and the eighth grade.

In the fourth grade, all pupils from the school population who attained regular school program and were present in class on testing days were included in this study. In the eighth

[1] The content of this subject largely corresponds to that covered in Science.

grade sample, approximately half the pupils had tests in the Croatian language, physics, chemistry, and biology, whereas the other half had tests in the English language, geography, and history. The division into these two groups was conducted by random sampling procedure. As in the fourth grade sample, all pupils who attended regular school program and were present in class on testing days were included in the eighth grade sample.

Data on pupils' gender, their subject marks, and the gender of their teachers in particular subjects were collected from the Croatian digital national database of all elementary schools. In some cases, when teachers' gender was not updated in the digital database, it was collected from the school administration directly.

Data analysis

SPSS version 15 has been used for assessing psychometric properties of the measures, descriptive statistics, and correlations between measures of school achievement. A series of two-way analyses of variance (two-way ANOVA) were performed as a method to explore pupils' and teachers' gender effects on school achievement, as well as student–teacher gender interaction effect. The two-way ANOVA was chosen for its simplicity and clarity in comparison to Hierarchical Linear Modelling method traditionally used in educational researches. The data in educational research studies are usually nested within levels (students within schools, schools within municipalities, etc.) and adequate statistical method should be HLM. In our research, pupils are nested within their teachers and it seems that assumption of independency of pupils chosen in the sample is violated and pupils are more homogeneous by their characteristics than they should be for ANOVA procedure, which could lead to underestimation of error variance and consequently to Type I statistical error (Osborne 2000). However, if the sample covers a large part or even the whole population of each higher hierarchical level, Type I error is smaller or none. Namely, due to the inclusion of the entire population of higher-level entity (in our case, teachers), the homogeneity of lower-level entities in analysis (in our case, pupils) does not increase at all. In such cases, the homogeneity of the observed population of pupils is equal to the homogeneity of a randomly selected sample of the population, which solves the problem of independence of observations. In this research the whole population of teachers was included (all schools in Croatia and all their teachers in particular subjects) and two-way ANOVA seems to be appropriate statistical test for gender differences in school achievement. In addition, we applied Bonferroni correction to adjust Type I error rate due to conducting series of ANOVAs for different subjects and measures of achievement. The alpha per comparison was set at 0.001.

Results

As in many other countries, the percentage of pupils taught by male teachers in Croatian elementary schools is very low and ranges from 6.0% to 45.0%. The share of male teachers is smallest in lower grades and in languages. The highest percentage of male teachers is observed in the eighth grade where they teach physics (45.0%), history (33.1%), and geography (32.0%). In order to examine the effect of pupils' and teachers' gender on pupils' school achievement, a series of two-way ANOVAs was performed. For each subject the main effects of pupils' gender and teachers' gender on pupils' achievement were examined. The results were calculated separately for two school achievement measures (tests and school marks) and for two age samples, and presented in separate tables. In order to examine the student–teacher gender interaction effect, the series of F tests were calculated and

presented in last columns of each table. If such interaction exists, the assumption of different effect of teachers' gender on school achievement of girls and boys could be confirmed. Apart from F tests, the estimates of effect size—partial eta squared—were also calculated and presented belong with corresponding F measures in tables.

Students' and teachers' gender effect on school achievement in fourth grade pupils

Gender differences in school achievement for the fourth grade pupils' are presented in Tables 1 and 2. Regardless of the type of achievement measure used (tests or marks) girls perform better in languages. In Math and Nature & Society, girls also have better marks than boys (Table 2), but no gender differences were observed when achievement was measured by standardized tests (Table 1).

The differences in pupils' achievement attributable to teacher gender are also present in the fourth grade. Pupils taught by female teacher achieve higher results in all standardized tests (Table 1), and have higher marks in all subjects, except Nature & Society where no difference is observed (Table 2).

However, the partial etas square indicate that even if students' and teachers' gender effects are statistically significant for some of the subjects in the fourth grade, the effect sizes are very low. Since all of the etas do not reach 0.01, it indicates that proportion of the total variation of school knowledge attributable to the gender factor is less than 1% and practically very small or even negligible (Cohen 1988).

Students' and teachers' gender effect on school achievement in eighth grade

Gender differences in school achievement in the eighth grade are not so uniform. Although girls have better school marks in all subjects (Table 4), the gender differences in standardized tests show a mixed pattern (Table 3). Girls achieve higher results in languages tests, chemistry, and biology tests; boys get better results in physics and geography tests; while no difference was observed in history tests.

Teacher gender differences in the eighth grade are stable if pupils' knowledge is measured by standardized tests (Table 3). The advantage of female teachers is noticeable in all seven subjects' tests. However, when school achievement is measured by school marks, as presented in Table 4, female teachers awarded higher marks only in geography. Male teachers awarded higher marks in the Croatian language, physics, and biology, whereas no differences were observed in foreign language, chemistry and history.

The effect sizes (partial η^2) of students' and teacher's gender on school achievement in the eighth grade are generally a bit higher comparing to the fourth grade. Still, the majority of etas do not overreach the Cohen (1988) cut-off point of 0.01, especially when the effects of teachers' gender are considered. Thus, even if some of the differences in students' school achievement are significant, and could be attributed to the teachers' gender, those differences are practically very small.

Student–teacher gender interaction effect on school achievement

The interaction effect results, as an indicator of possible different effect of teacher's gender on achievement of girls and boys in elementary school, are almost all statistically insignificant (Tables 1, 2, 3, and 4). There is no significant student–teacher gender interaction effect on school achievement measured by marks or tests in the fourth grade, and only one significant interaction effect is observed in the eighth grade. This significant student–teacher

gender interaction effects are observed for chemistry. The interaction is present when the achievement is measured by standardized tests, as well as when measured by school marks. A closer look into subgroups means can reveal the meaning of this interaction. On the standardized chemistry test, the mean result for girls taught by female teachers was M_{GF}= 37.34, whereas mean for boys taught by female teachers was M_{BF}=34.89. The means for girls and boys taught by male teachers were M_{GM}=34.14, and M_{BM}=34.25, respectively. As it can be seen from the main effect, female teachers perform better than their male colleagues in general (F=31.44; p<0.001; Table 3), but this is evident only if they teach girls. A slightly different interaction pattern can be seen if the school marks are analyzed. The average marks in chemistry for girls and boys taught by female teachers were M_{GF}=3.63, and M_{BF}=3.19, respectively. If taught by male teachers, girls have a mean mark of M_{GM}=3.58, and boys of M_{BM}=3.23. It is evident that, by the main effect, girls have much better marks than boys (F= 618.87; p<0.001; Table 4), and that there is no significant main effect of teachers' gender (F=0.01; p=0.921; Table 4). The interaction effect shows that girls have somewhat better marks if they are taught by female teachers, and boys have somewhat better marks if they are taught by male teachers. Still, this interaction effect is not as pronounced as the interaction yielded by standardized chemistry tests. Finally it should be noted that even if a significant interaction effect is observed in case of chemistry, the effect sizes of teacher–student gender interaction measured by eta square indicate its limited practical importance.

Before we proceed to the discussion, it should be clarified that, despite of the very low etas squares and interpretation norms proposed by Cohen (1988), we consider statistically significant gender differences in school achievement interpretively important to some extent. We wish to propose that, in this research, variance-accounted-for indexes, as eta, make our effects look smaller than they really are in terms of their substantive significance. The rationalization for this position is based on the following three facts:

Firstly, the size of student samples used in this study is very close to the population parameters. Our fourth grade sample covers over 90% of the population, while our eighth grade sample, depending on measured school subject, covers about 50% of the population. Therefore, the obtained differences between gender groups are very stable and close to real population differences. Secondly, even small differences in achievement attributable to students' or teachers' gender can have strong educational repercussions for individuals. In the Croatian education system, school grades at the end of primary school (i.e., the end of the eighth grade), are essential for successful enrolment in preferred high schools. Only a point or two above or below the threshold level for enrolment in a desired high school can permanently change the students' professional path and their future career, and consequently their lifelong well-being. Thirdly, meta-analysis in education-related studies, with the goal of identifying the determinants of educational achievement, have attributed a very small portion of achievement variance to teachers' characteristics. For example, according to the meta-analysis by Marzano (2000), teachers' characteristics can explain less than 5% of student achievement variance, with teachers' qualifications and experience as main predictors. Therefore, if the teachers' gender can explain 0.5% or 1% of variance in the student achievement, it is small, but substantively significant.

Discussion

The results have shown that gender differences in elementary school achievement exist in various subjects and in most cases are in favor of girls. However, when school achievement was measured by school marks, these differences were more pronounced than when

measured by standardized tests. In the fourth grade girls had better marks in all subjects, but better results in tests were shown only in languages. In the eighth grade, girls had again higher marks in all subjects, whereas higher results in the tests were observed only in languages, chemistry, and biology. Boys achieved higher results in physics and geography tests, while no gender difference was observed in history tests. These comprehensive results showing that girls are, on average, better than boys by marks in many school subjects are consistent with many other studies (e.g., Demie 2001; Gibb et al. 2008; Duckworth and Seligman 2006; Ciarrochi et al. 2007; Leeson et al. 2008; Steinmayr and Spinath 2008). However, gender differences observed in the present study decreased, or even changed direction, when objective tests as measures of school achievement were used.

A number of studies have attempted to explain why school marks, as a measure of school achievement, favor girls (Buzhigeeva 2004; Resing et al. 1999; Duckworth and Seligman 2006; Matthews et al. 2009; Steinmayr and Spinath 2008; Cleary and Chen 2009). Certainly, a number of girls' characteristics make them more conform to school setting and traditional ways of teaching then boys, and school marks regularly take this into account (Carrier 2009). Moreover, school marks are partially formed on the basis of homework and home assignments. In this respect, girls are also more disciplined than boys and, according to Duckworth and Seligman (2006), girls spend twice as much time writing their homework as boys. Furthermore, Younger et al. (1999) have found that a large number of teachers define their ideal student as female. They see girls as more organized, better self-learners, more confident and articulate, more able to conform, and more likely to ask for help. This led us to another important aspect of gender differences in school marks—personality traits. Spinath et al. (2008) found that conscientiousness is a significant predictor of school performance in a girls' sample, but not in boys', which may additionally explain the gender differences in school marks, since it is known that, of all personality traits, conscientiousness is the strongest predictor of school achievement (Maltby et al. 2007), and a single personality trait that can be compared to intelligence in terms of predictive power (Poropat 2009; Bratko et al. 2006). Furthermore, teachers are more likely to characterize girls as agreeable (Laidra et al. 2007), which is related to maintaining good relationships with colleagues and teachers, which is likely to provide an advantage to girls in school performance, especially in obtaining high school marks.

Regardless of the achievement measure, girls obviously outperform boys in languages. They have better school marks and higher results in language tests in the fourth and in the eighth grade. Learning vocabulary, grammar, and writing skills could be attributed to higher verbal abilities of girls (Yarborough and Johnson 1980; Meece et al. 2006). In addition, stereotypical beliefs pertaining to sex roles and social expectations could induce girls to have more positive attitudes toward languages and reading (Meece et al. 2006). On the other hand, boys performed better than girls in standardized tests in physics and geography. Such results may be due to better numerical and spatial abilities of boys (Buzhigeeva 2004), as well as social expectations for boys to have positive attitudes toward science and mathematics (Meece et al. 2006).

The results of this study have also revealed gender differences between teachers' performance measured by school achievement of their pupils. Female teachers were generally more successful in teaching than their male counterparts, especially if the pupils' knowledge was measured by standardized tests. This is consistent with other studies on teachers' gender effects on teaching and students' school performance (UNESCO 2000; 2005; Stake and Katz 1982). Another possible explanation of lower success of male teachers may be related to various problems that men encounter in their school environment. Although most researchers believe that teaching profession contributes to breaking stereotypes and prejudices, men as teachers may still face different problems at their working place, such as hostility and suspicion, since teaching is still largely considered a feminine domain (Carrington and Skelton 2003).

Additional important findings of this study are related to the fact that the observed differences in the performance of male and female teachers largely depend on the type of school achievement measure. In the fourth grade, the pupils who were taught by female teachers had higher scores on standardized tests and, at the same time, had higher marks in almost all subjects. In the eighth grade female teachers were also more successful in all subjects when the achievement is measured by tests, but when the school marks were used, male teachers awarded higher marks in the Croatian language, physics and biology. As noted above, some studies offered possible reasons for better achievement of female teachers, and thus, results that male teachers tend to give higher marks in certain subjects should be further investigated. It seems that other variables apart from teachers' gender should be taken into account. For example, in his study Klein (2004) accentuates the importance of some other teachers' variables, beside gender, that moderate their performance. He revealed that older and more experienced teachers incline to give higher marks, and that this trend is more pronounced in male teachers' sample. Furthermore, the class size may also affect the difference in marks given by male and female teachers. Male teachers are more likely to give higher marks in smaller classes, while female teachers do so when classes are larger (Klein 2004). Therefore, in order to obtain a more complete picture of teachers' gender effect on pupils school achievement, it is necessary to take into account other factors that may moderate this relation, such as teachers' age, experience or class size. According to our results, it is reasonable to conclude that relation between teachers' gender and their teaching effectiveness is significantly blurred by the method of measuring school achievement. If achievement is measured by standardized tests, female teachers show, to some extent, greater efficiency. In the case of school marks unsystematic differences between male and female teachers were observed, especially in higher grades. However, the observed differences attributed to the teachers' gender have very small effect size (etas) and teachers' gender explain very low proportion of the pupils' school achievement variance. Thus, it can be concluded that the teachers' gender is not of great practical importance for the pupils' achievement, and that inter individual variance in the school achievement is likely to be far more related to other personal, class and school factors (Babarović et al. 2009).

Finally, as a bottom-line of the study, our results have shown that pupils' gender differences in school achievement are basically independent of teachers' gender. Interaction effect between teachers' and pupils' gender on school achievement occurred only once in the eighth grade, in the case of chemistry. Those results are consistent with other studies that have demonstrated the absence of teachers' gender effect on the educational achievement of boys and girls (e.g., Skelton 2003; Francis et al. 2008; Carrington et al. 2007; Carrington and McPhee 2008; Driessen 2007; Hutchings et al. 2008; Marsh et al. 2008). The single significant interaction effect observed in chemistry could be explained by possible differences in teaching approaches employed by male and female teachers while teaching chemistry (Boz and Uzuntiryaki 2006), but this assumption should be additionally confirmed by a more focused research. Finally, excluding this single significant interaction effect, teachers' gender was not an important moderating factor in this study. Gender differences in teachers' performance are unchanged by pupils' gender, or, in other words, recorded pupils' gender differences do not depend on teachers' gender.

The stability of findings revealed in this study can be supported by comparison of results obtained in younger and older samples of elementary school pupils. The key findings are similar in both age groups: (1) the school achievements of girls measured by school marks, are higher than that of boys, but when the standardized tests are used gender differences are not so uniform; (2) pupils taught by female teachers attain better results on standardized tests, while gender differences in teaching performance are not systematic in the case of

school marks; (3) interaction effects of teachers' and pupils' gender on school achievement are generally insignificant. This resemblance of results obtained in different age cohorts of pupils, can uphold to some extent the universality of carried conclusions in Croatian educational realm.

The main limitation of this study is that it focuses solely on gender variables and does not take into account other confounding variables that might influence our findings. The variables of potential interest are predominantly related to teachers' gender effect on pupils' school performance. The factors that can moderate this relation are teachers' age, experience or class size. It is possible, but not very likely, that male teachers in Croatian primary education system are on average older, more experienced, or work in smaller classes than female teachers. However, even if inclusion of those variables could change conclusions on teacher gender effect on their students' marks or test results, it is not likely to influence the findings on absence of teacher–pupil gender interaction on school performance. The second limitation of the study is its cross-sectional design which implies that all the results obtained in one age cohort of pupils and their teachers cannot be directly related to the results of other age/grade cohorts. Therefore, the comparison of findings on these two cohorts should be done with caution, and interpreted just as a weak indication of stability of research results. The third possible methodological problem of this study is related to the quantity of teacher–pupil interaction. We do not have the data of students' exposure to a specific teacher over a specific period of time. We simply assume that during the periods of 4 or 2 years (depending on the pupils' age and subject) pupils are exposed to the same teacher. Yet, in the real world, teachers change their jobs, move, and take longer sick-leaves. These events can reduce the teacher–student relations, diminish mutual influences and blur the proposed outcomes of our interest. However, we suppose that substitutions of teachers during education periods are not so frequent and are randomly allocated to the teacher's gender.

Practical implications of this study are related to the following two findings: the first is absence of teachers–pupils interaction effect on school performance, and slightly better results of pupils' thought by female teachers. The absence of gender interaction on school marks and test results divert us from the ideas of *gender matching policy* in primary schools in Croatia. According to our results, it cannot be expected that boys will benefit if they have a male teacher instead of female, or that the opposite applies for girls. In that context, the policy efforts made in some European countries (EACEA 2010), in terms of intentional increase in the number of male teachers with the purpose of increasing the attainment of boys in primary schools, are not applicable to Croatian education policy. The fact is that both boys and girls will probably have somewhat better results in objective knowledge tests when they are thought by female teachers. Thus, educational policy makers should not be focused on quantity of male teachers in Croatian primary schools, but on their quality. The probable reason for lower achievement of male teachers is not in their gender, but in systematic negative self-selection of men in teaching profession. The reasons for that are nicely summarized by Cushman (2007). He concludes that there are three key reasons why men find a teaching job unattractive: low salaries, poor professional reputation and status as well as problems related to working with children. The latter includes stereotypes about working in primary schools as a typically female profession where all boils down to taking care of children and patience, or to "extended form of motherhood". In the eyes of a great number of men, the teaching profession is perceived as a job where typical feminine traits are needed, and men in teaching occupations as insufficiently masculine. These reasons seem to be very applicable for Croatian conditions too. Educational policy should strive on to break this gender role prejudice, rise teachers' salaries, and improve their social position and reputation if more competent men are wanted to choose teaching careers. However, in the countries

where teaching profession is considered prestigious and teachers earn reasonably high salaries (e.g., in Finland and Luxembourg), the teachers at compulsory school levels are still predominately female (EACEA 2010). This suggests that teaching in primary schools is firmly associated with the female gender role, and that financial benefits will not by themselves attract man in teaching. Several European countries have developed other concrete initiatives aimed at attracting more men into the profession. Ireland have launched specific media campaigns to attract men into teaching at primary level, Netherlands have introduced a special program to prevent male drop-out from teacher education, while several other countries started diverse initiatives for attracting men into teaching (e.g., Czech Republic, Lithuania, UK, Sweden). If Croatian policy makers decide to develop or adopt some of the programs to attract men into the profession, the policy should be focused on the professional excellence of male teachers in primary schools rather than on their number.

The second aspect of political implications is related to the observed gender mismatch between school marks and objective test results. It is especially pronounced in the eighth grade where girls outperform boys by marks in almost all school subjects, while the results in objective tests show mixed pattern of gender differences. It seems that the observed gender gap between boys and girls in Croatian primary schools is influenced by the assessment methodology. School marks, as partly subjective measures, favor girls and overestimate their knowledge comparing to objective exams. Engagement in home assignments, participation in class, class behavior, and verbal competences exhibited during oral examination, as integral elements of school marks, by their essence favor girls. Due to the educational importance of school marks at the end of primary school (enrolment in high school is entirely based on primary school marks), the education policy should be more sensitive to equal gender opportunities in attaining school marks accordant to pupils' actual knowledge. The education authorities should make every effort to develop more gender sensitive Regulations on Assessment in Croatian primary schools in order to diminish gender gaps in school marks unrelated to objective differences in school-related competences.

Appendices

Table 1 The main effects of pupils' and teachers' gender, and pupil–teacher gender interaction effects on school achievement measured by standardized Tests (10-year-old pupils)

Subject	Gender	Pupil gender effect				Teacher gender effect				Interaction effect (F) and partial η^2
		M	SD	N	F and partial η^2	M	SD	N	F and partial η^2	
Croatian language	F	60.34	18.97	22,346	324.51*	57.13	19.38	42,092	118.28*	2.20
	M	53.46	19.32	22,842	0.003	53.21	20.01	3,096	0.007	0.000
English language	F	59.42	24.97	19,666	78.09*	57.26	26.04	37,381	94.31*	0.01
	M	54.52	26.89	20,109	0.002	51.88	26.16	2,394	0.002	0.000
Math	F	52.68	23.53	22,296	0.03	52.79	24.49	42,026	49.84*	0.59
	M	52.45	25.50	22,816	0.000	49.57	25.03	3,086	0.001	0.000
Nature & Society	F	61.14	21.52	22,297	1.07	61.31	21.99	42,027	115.07*	3.64
	M	60.88	22.65	22,816	0.000	56.91	23.23	3,086	0.003	0.000

*$p<0.001$

Table 2 The main effects of pupils' and teachers' gender, and pupil–teacher gender interaction effects on school achievement measured by the subjects' marks (10-year-old pupils)

Subject	Gender	Pupil gender effect				Teacher gender effect				Interaction effect (F) and partial η^2
		M	SD	N	F and partial η^2	M	SD	N	F and partial η^2	
Croatian language	F	4.31	0.86	23,624	469.43*	4.11	0.92	44,771	7.70*	4.45
	M	3.92	0.95	24,454	0.010	4.07	0.96	3,307	0.000	0.000
Foreign language	F	4.35	0.89	23,610	243.57*	4.20	0.97	44,997	22.44*	0.41
	M	4.05	1.03	24,439	0.005	4.11	0.99	3,052	0.000	0.000
Math	F	4.09	0.98	23,629	44.64*	4.01	1.00	44,775	10.15*	4.15
	M	3.94	1.03	24,454	0.001	3.96	1.06	3,308	0.000	0.000
Nature & Society	F	4.23	0.92	23,629	104.48*	4.13	0.95	44,776	2.80	3.38
	M	4.03	0.98	24,455	0.002	4.10	0.97	3,308	0.000	0.000

*$p<0.001$

Table 3 The main effects of pupils' and teachers' gender, and pupil–teacher gender interaction effects on school achievement measured by standardized tests (14-year-old pupils)

Subject	Gender	Pupil gender effect				Teacher gender effect				Interaction effect (F) and partial η^2
		M	SD	N	F and partial η^2	M	SD	N	F and partial η^2	
Croatian language	F	49.59	17.16	10,761	436.50*	45.40	17.83	19,754	77.23*	0.62
	M	40.62	17.31	10,864	0.020	41.71	17.28	1,871	0.004	0.000
English language	F	61.79	24.52	8,342	75.38*	58.64	25.37	15,766	21.54*	0.11
	M	55.07	25.84	8,485	0.004	54.84	25.76	1,061	0.001	0.000
Physics	F	53.97	21.33	10,873	26.60*	55.82	21.23	11,986	72.03*	1.57
	M	55.45	21.31	10,909	0.001	53.35	21.38	9,796	0.003	0.000
Chemistry	F	37.04	17.38	10,864	12.21*	36.17	17.41	19,016	31.44*	14.49*
	M	34.81	17.20	10,904	0.001	34.20	16.59	2,752	0.001	0.001
Biology	F	43.35	18.45	10,873	22.30*	42.53	18.42	19,265	56.49*	2.58
	M	41.04	18.22	10,909	0.001	39.61	17.80	2,517	0.003	0.000
Geography	F	41.50	16.54	10,574	127.66*	43.52	17.08	14,564	53.06*	0.01
	M	44.34	17.57	10,843	0.006	41.69	17.15	6,853	0.002	0.001
History	F	45.53	14.66	10,574	6.58	46.06	15.05	14,331	18.97*	0.00
	M	46.08	15.80	10,843	0.000	45.29	15.63	7,086	0.001	0.000

*$p<0.001$

Table 4 The main effects of pupils' and teachers' gender, and pupil–teacher gender interaction effects on school achievement measured by the subjects' marks (14-year-old pupils)

Subject	Gender	Pupil gender effect				Teacher gender effect				Interaction effect (F) and partial η^2
		M	SD	N	F and partial η^2	M	SD	N	F and partial η^2	
Croatian language	F	3.83	1.04	22,401	1472.87*	3.50	1.10	41,523	23.25*	4.16
	M	3.19	1.06	23,019	0.031	3.57	1.11	3,897	0.001	0.000
Foreign language	F	3.79	1.12	22,438	527.78*	3.55	1.16	41,997	3.14	1.80
	M	3.31	1.15	23,049	0.011	3.51	1.16	3,490	0.000	0.000
Physics	F	3.56	1.10	22,438	1067.67*	3.37	1.12	25,086	18.74*	0.03
	M	3.22	1.11	23,052	0.023	3.42	1.12	20,404	0.000	0.000
Chemistry	F	3.62	1.11	22,415	618.78*	3.41	1.13	39,772	0.01	7.90*
	M	3.20	1.11	23,040	0.013	3.40	1.13	5,683	0.000	0.000
Biology	F	3.87	1.06	22,441	827.71*	3.63	1.10	40,333	7.22*	1.23
	M	3.40	1.09	23,056	0.018	3.67	1.10	5,164	0.000	0.000
Geography	F	3.79	1.09	22,439	745.36*	3.65	1.11	30,912	20.27*	0.24
	M	3.49	1.12	23,050	0.016	3.60	1.12	14,577	0.000	0.000
History	F	3.80	1.11	22,439	1061.88*	3.61	1.14	30,328	0.00	0.62
	M	3.43	1.14	23,054	0.023	3.61	1.15	15,165	0.000	0.000

*$p<0.001$

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