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INFLUENCE OF FAMILY FACTORS ON FEMALE AND MALE STUDENTS' LITERACY DEVELOPMENT

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ABSTRACT

The research provides an analysis of students' mathematical, reading and scientific literacy. PISA data are the basis of the study. Correlations and regression models are used in the research. The paper presents models for each type of literacy for all students, separating female and male students. It shows that gender-based educational models are quite common for mathematical, reading, and scientific literacy. There are typical models for female and male students that diverge from each other. For female and male students, the same factors produce quite different effects. For male students, family socioeconomic status is very important; they especially need mothers' time and care. Female students depend on family socioeconomic status and mothers' support less; they need their fathers' example of proper socioeconomic behavior. Female students need their mother's attention, time, care, and support, most of all for improving their scientific literacy. Moreover, school factors are not very important for students' mathematical, reading and scientific literacy improvement, especially, in comparison with family ones. The basic level of mathematical knowledge in the model is not lower for female students than for male ones. It is even a bit higher. Thus, the basic level of mathematical literacy is not determined by sex. Whereas the reading literacy basic level of male students' knowledge is significantly lower than female ones.

Disciplinary: Education Sciences (Education Technology, Education Development), Socioeconomics.

1. INTRODUCTION

The current number of people under 30 years old is the largest in world history. Due to world

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population growth, there are plenty of young people in each country, especially in developing ones. Education is one of the most important issues affecting youth and adolescents. It allows them to be a part of society and become successful in their future life. There is no real future without a high-quality education. Thus, this article concentrates on educational issues, especially at higher levels of education. The Programme for International Student Assessment (PISA) results in mathematics, reading, and science is at the focus. Selection data allows the comparison of different regions and countries due to a standardized methodology. Moreover, the time period of the research helps to exclude some temporary influences and tendencies and focus on long term effects.

At the beginning of the XXI century, directions of thinking about student literacy changed. Family values began to dominate human thought all over the world, which was reflected in scientific research from that time. The first group of studies discussed family and cultural practices that influenced students' values. However, other research also mentions family values. The second group focused on sociological specifics and factors of youth literacy. The third group specified different types of literacy and tested factors for those systems. This research study is meant to be the largest.

2. LITERATURE REVIEW

Many studies analyzed social factors that influenced students' literacy. They took into account rather standard factors, such as family income, mothers' employment, the effect of different school programs, etc. However, the main focus of the studies concerned government programs in related fields, rather than directly in education. Esping-Andersen analyzed PISA data for seven countries, including the United States, United Kingdom, Germany, Spain, Denmark, Norway, and Sweden (2007). She found that mothers' education was more significant for children's academic achievements than that of the father. However, socioeconomic status affected children's literacy level less than parents' education. Cultural capital was one of the most important factors that influenced children's education. Additionally, mothers' occupation—in the case of part-time job — usually did not negatively affect children's literacy (and even full-time jobs did not have a negative impact, in any of the countries listed). Esping-Andersen showed that mothers' employment is generally positive for children's life chances, as it reduces the risk of poverty. If external child care was of high quality, maternal employment had no negative effects on child outcomes (Esping-Andersen 2007). Esping-Andersen also showed that children of poor families had worse academic achievements and the key differences between two children were formed during the first 6 years of their life (2008). The most interesting result covered mothers' employment. Children's education and literacy were significantly better if mothers had stable jobs. However, many mothers were first-job seekers and often had no opportunity to get a stable job due to the labor market (Nickell 1997; OECD 1999; Esping-Andersen and Regini 2000). Mothers' job security was one of the predictors for positive parenting. Thus, previous Scandinavian research showed that mothers', including those with higher education, were willing to trade off higher lifetime earnings in favor of a more secure job (Jensen 2002). In many countries, the number of such jobs was lower than the number of mothers' who wanted to work. Therefore, Esping-Andersen proposed to address this issue through government policy. She also showed that such workplaces were the most important for mothers with children aged 0-6 years old. The other analysis based on PISA data predicted the chances of children for future

mathematics-related occupations (Schulz, 2005). That study showed that place of birth, academic program and relative grades were less important for getting mathematics-related occupations than mathematical literacy, self-efficacy, and interest in math. Thus, literacy itself was a very important result variable. One more study discussed the issue of necessity to change models for the prediction of future academic results (Zanten, 2005). The article proposed that factors previously discussed in scientific literature had other effects due to many education policies directed at parents, teachers, and schools. At last, one more research must be mentioned. Okpala analyzed effects of public schools' expenditures in sub-Saharan Africa (2006). This is quite similar to other articles; however, instead of controlling the type of literacy, some region factors have been taken into account.

Other studies analyzed additional family and personal factors. Thus, Choi, Lee, Yoo, and Ko showed that academic achievement was positively related to life satisfaction (2019). Life satisfaction could also mediate academic stress. The other option to reduce academic stress was fairness from parents and teachers, which increased the subjective well-being of students. All the factors in this research had not been connected with socioeconomic status but were important for students' academic achievements. In this field, one more analytical article combined previous research and postulated that gaps between students in each country were rather significant (Waldfogel 2012). The task of the educational system, according to the author, was to close such gaps. Undoubtedly, it is an important task; however, educational systems have to provide opportunities for development to all students, including those with the highest performance. Therefore, it must close gaps for students with a low level of ability and provide opportunities for highly skilled students to excel.

Educational programs and principles were combined and discussed in several books about adolescent literacy. The main idea of these books was to discuss different pros and cons of diverse educational programs and research propositions. The books paid attention to a new reality in which educational programs were developed, especially in regard to the Internet, mobile technologies, and social networks (Sturtevant et al. 2016; Davidson and Koppenhaver 2017). Quite close to these books was an article that specified how the development of social media literacy would lead to prevention intervention of smoking and other bad habits in close civilizations (Salgado et al., 2011).

Overall, there several approaches to studying literacy. The vast majority of research analyzed one or more types of literacy. None of them investigated and compared factors' influence on all four of them. Much recently published research used data from the 1990s, which is, of course, not current. There was a lack of research that used long-term macro data for many countries and regions as a single data set. Usually, studies focus on microdata and analysis at the family level. Previously formulated results were not proved by statistical data during the last decade, especially in the case of family income influence. Currently, these socioeconomic variables must be changed for other ones to improve the model's statistical significance. One more argument to such a change is that parental education and family income are inter-correlating variables. The vast majority of studies took gender as a single variable, without considering different econometric and regression models for girls and boys. Just one study (Rouland et al., 2013) assumed divergent models and found significant differences. Thus, further studies that provide different sex models are necessary.

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2.1 HYPOTHESIS

The current study is important for both theory and practice. It will develop educational theory in the context of comparing different types of literacy. As a result, the study will help to understand whether different types of literacy are similar or different from each other. What are their similarities and differences? The research analyzes three types of models for all students, female and male. It provides an opportunity to compare. Are there any similarities between the models for one type of literacy, or for each type of student? Theoretical parts of the research also extend knowledge about the parent's role in students' literacy development. In contrast with previous research, this study provides models for family and school with explanatory variables. As a result, it is possible to examine the parental role in students' literacy, including sex specifics, as well as how the role of each parent (how family and school factor in students' literacy). High coverage of the research helps to find similarities for all students, female and male. Moreover, it helps to compare different types of literacy. Thus, this research is extremely important for science due to its scope in the various types of literacy and its simultaneous presentation of different models for both sexes.

The hypotheses of the research are:

1) Mathematical, reading and scientific literacy are more similar according to explanatory factors.
2) The models for each sex are more similar to each other than the models for each type of literacy. In other words, female and male students have their own models of literacy improvement that are quite stable between different types of literacy. However, gender diversities remain stable.
3) Family explanatory factors are much more important for each type of literacy than school factors. They explain the larger share of dependency variable variance.

3. METHOD

Research methods include several statistical instruments, based on research issues. At the first stage, the absence of statistical differences between parts of the samples has been proven. The research uses four data samples: one for each year. PISA collects data every three years. It is reasonable to suggest that statistical differences are possible between different parts of the sample due to difference in time. Thus, it is important to prove that statistical data can be combined into one sample. To prove this fact, several non-parametric tests for K independent samples are used to find significant differences between the groups. The Kruskal– Wallis H test, Jonckheere-Terpstra test, and the median test are applied to define differences between parts of the sample. These tests are applied to all independent variables; however, none of them indicated any significant differences.

The second stage includes regression. Regression research is based on the ordinary least squares method and t-statistics. The third stage is the stage of instrumental variables. The socioeconomic index is definitely correlated with the socioeconomic status of an individual.

3.1 DATA

The research is based on the Programme for International Student Assessment (PISA) data. PISA observes 15-year-old students at four keys: mathematics (math), literature (reading), science, and collaborative problem. PISA is a triennial international survey with standardized questions, including localization. In each field, the main aim of the survey is to assess literacy levels. The first tests started in the year 2000. However, data suitable for analysis appeared in 2006. Thus, present research includes data since that time. Math, reading, and science data of proper quality are available for the years 2006, 2009, 2012, and 2015.

4. RESULT AND DISCUSSION

4.1 MATHEMATICAL LITERACY

There are five significant models for general mathematical literacy. Here, they are presented in Table 1. All regression coefficients in the models are significant with t-statistic above 2 In absolute value. Two models for general mathematical literacy have explanatory variables among parental ISEI (International Socio-Economic Index of Occupational Status, this index converts information about parents' education and occupation into income) and three models among school factors. The most significant, according to R-square 0.323, is the model describing the relationship between general mathematical literacy and the highest and mothers' ISEI. Both variables are included in one model. Each additional percent of the highest ISEI increases mathematical literacy among all students by 10.7 scores and each mothers' ISEI additional percent reduces it by 8.5 scores. Thus, the best opportunity, according to this model, is a family in which the father has a high ISEI and the mother is not working. Alternatively, if the mother 's ISEI is the higher one, it should be as high as possible due to the simultaneous reduction and increase of mathematical literacy during the rise of the mother's ISEI. If mothers' ISEI is higher, each additional percentage point will increase mathematical literacy among students by 2.2 scores. The second model with independent variables (mothers' and fathers' separate ISEIs) has an R-square of just 0.175 and is not interesting for future research due to its low explanatory power.

Three models describe mathematical literacy among students of both sexes as contingent on school factors. Each of these models has an R-square between 0.081 and 0.110, which is very low. None of the models include more than one explanatory variable. Generally, class size and private schools have a negative influence, while government school funding has a positive effect on mathematical literacy. The most significant effect on mathematical literacy is provided by governmental funding of schools. Each additional percentage of governmental funding for schools adds a score of 1.2 to mathematical literacy. The class size provides a higher absolute effect, but dramatically less explanatory power. Nevertheless, any of the school-related variables have three times less effect than parental factors. Thus, for mathematical literacy among all students, the highest ISEI and mothers' ISEI is the most significant explanatory variables (Table 1).

Regression models for male students are quite similar to general models of mathematical literacy and present the same factor-based relationships. However, they are different for female students. The models for female students differ in key explanatory variables. The models include all three family factors: the highest ISEI, and the ISEI for both fathers and mothers. In each model, the highest ISEI has the least effect on female students' mathematical literacy. Mothers' ISEI influences negatively and fathers' influences positively. Meanwhile, fathers' ISEI influence is higher than that of the mother. In other words, the best family circumstances for female students' mathematical literacy development are a highly- educated, employed father and a nonworking mother. If the mother's ISEI is higher than the father's, it may negatively influence female students' mathematical literacy. The worst circumstances are nonworking or absent fathers and highly- educated working mothers. The main difference between models for all students (or for male students) and models for female students is the father's role. For female students, fathers' ISEI, which implies education, employment, and

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income, is directly relevant. Thus, fathers' education and behavior are more important in a positive context for female students than for males, or for average students of both sexes.

Table 1. Regression models for students' mathematical literacy

	Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
General	Constant	**371.8**	348.6	-		539.9	372.9	482.2
	Highest occupational status of parents	**10.7**	-	-		-	-	-
	Mother occupational status	**-8.5**	-3.7	-		-	-	-
	Father occupational status		6.8	-		-	-	-
	Size of class	-	-	-		-2.5	-	-
	Funding government	-	-	-		-	1.2	-
	Funding student fees	-	-	-		-	-	-1.1
	R-square	**0.323**	0.175	-		0.081	0.110	0.084
Female	Constant	330.6	269	**339.9**		538.7	372.1	479.1
	Highest occupational status of parents	2.5	1.9	**1.9**		-	-	-
	Mother occupational status	-4.5	-4.7	**-4.8**		-	-	-
	Father occupational status	5.2	5.9	**6.1**		-	-	-
	Size of class	-	-	-		-2.6	-	-
	Funding government	-	0.8	-		-	1.1	-
	Funding student fees	-	-	**-0.9**		-	-	-1.1
	R-square	0.222	0.287	**0.294**		0.089	0.103	0.089
Male	Constant	**335.1**	356.6	-		539.7	377.2	486.6
	Highest occupational status of parents	**11**	-	-		-	-	-
	Mother occupational status	**-8.9**	-4	-		-	-	-
	Father occupational status	-	7	-		-	-	-
	Size of class	-	-	-		-2.4	-	-
	Funding government	-	-	-		-	1.1	-
	Funding student fees	-	-	-		-		-1.1
	R-square	**0.340**	0.180	-		0.070	0.101	0.088

Additionally, school factors explain one-third of family factors, which are similar to models for male students. Together, all factors explain 0.294 of mathematical literacy variance among female students, which is less than in other models for this type of literacy. Class size and funding by students' fees negatively influence female students' mathematical literacy, and government funding has a positive impact. The main difference in the models for female students is that they combine family and school factors into one model. As a result, one of the school factors is included in the best explanatory model. This factor is the funding of student fees. It provides less influence in comparison with family factors but has a rather important effect. Government funding has less explanatory power in comparison with funding by student fees. Thus, female students' mathematical literacy is lower if they pay for their schooling. Due to the analysis of many different countries, it is possible to suppose that the issue is not in the fee, but in the necessity to pay. Usually, students who have to pay for school have a lower academic level. Thus, these students pay for education due to their low mathematics knowledge. However, there is one more possible explanation. Government schools in all countries are more strictly controlled than private ones. In other words, there are some education standards for government-funded schools. In private schools, there is less government control. As a result, mathematical literacy is lower in private schools. According to an additional explanation of mathematical literacy, there is a variation among female students with government funding at 0.065 and with student fee funding at 0.072. The explanatory difference between these two variables is very low. According to this data, it is possible to assume that government education standards are more

significant than low academic levels of private school students. This assumption is based on the fact that the explanatory power difference between these two variables is very close, but government funding is a bit less. In other words, the common explanatory power of the variables is 0.065, and it is explained by educational standards. However, the small part (0.007) is explained by students' academic level. Nevertheless, funding education by student fee leads to a lower level of mathematical literacy among female students. Female students have lower explanatory power in all their models, which means that general factors influence them less. They are influenced by other variables not included in this research. Probably, these variables are connected with social and gender stereotypes, which were discussed in the introduction.

Each of the explanatory variables has a low level of correlation with mathematical literacy for all students, females, and males (Table 2). As a result, each of the independent variables can socioeconomic as an instrumental variable.

Table 2. Correlations for students' mathematical literacy

Mathematical literacy	Highest occupational status of parents	Mother occupational status	Father occupational status	Size of class	Funding government	Funding student fees
General	0.34	0.15	0.29	-0.28	0.33	-0.29
Female	0.35	0.18	0.31	-0.3	0.33	-0.3
Male	0.31	0.12	0.26	-0.27	0.32	-0.3

As previously discussed, the best models include instrumental variables. These models are highlighted in bold in Table 1. What does it mean that the explanatory variables are also instrumental? This means that they are not just related, correlated, or connected with mathematical literacy, but they exactly determine it. These factors explain mathematical literacy variance with direct and indirect connections. The research assumes that this fact is determined by ISEI formalization. This variable is an indirect reflection of education levels, employment, and income levels. Such measurement excludes correlation and frames the variables as instrumental ones.

4.2 READING LITERACY

Results for reading literacy are quite similar to mathematical data. Thus, the best model for all students' reading literacy depends on two explanatory variables: the highest ISEI and the mothers'. Overall, the explanatory power of the model is 0.318. Each percent of the highest ISEI adds 9.6 scores to the reading literacy of all students and each percentage of mothers' ISEI reduces the result variable by 7.7 scores. These figures are less than those of mathematical literacy. Basic levels of reading literacy are also less than the mathematical by 26.7 scores. Thus, reading literacy levels are less than mathematical, with all other elements being equal. Reading literacy development claims even more than the highest ISEI (in comparison with mathematical literacy). All other statements for mathematical literacy in student development are also true for reading literacy. For male students, the best model is similar in kind to the model for all students. The only difference is that the lower basic level of reading literacy for male students has a slightly (0.3) lower influence on the basis of percentage for the highest ISEI. In other words, mothers' high ISEI provides even worse comparative effects for male students and the highest ISEI plays a smaller role. As a result, male students' reading literacy is lower than that of the average student. To improve it, these students must live in families with a high father's ISEI and a nonworking mother. Moreover, explanatory power by all of the factors

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is significantly less for male students in comparison with general models. This fact can be interpreted as a low dependence on male students' literacy by family ISEI and school factors. Previous studies have shown that male reading literacy can be explained by gender stereotypes, which appears to be justified by current results, especially in the context of a lower basic level of reading literacy.

4.3 SCIENTIFIC LITERACY

Scientific literacy models are quite interesting due to their structural diversity from models of mathematical and reading literacy. The best model for students of both sexes includes three variables: the highest ISEI, the mother's ISEI, and the funding of school education by student fees. This model has sufficiently high explanatory power according to R-square 0.362. The level of basic scientific literacy is a bit higher than the average basic literacy of any type. Scientific literacy in general positively depends on the highest ISIE and negatively depends on the mothers'. The influence of these variables is quite similar to that of the model for reading literacy. Thus, results, in this case, are similar. However, scientific literacy depends on what percent of a school's funding is covered by student fees. The higher the percent, the lower the scientific literacy. Each percent reduces scientific literacy by a score of 0.5 (that is, almost two times less) than for the mathematical and reading literacy of female students. In other words, scientific literacy is the only type of literacy influenced by all students by funding school education with student fees. All other types of literacy generally do not depend on it. The best model for male students is similar to the best model for all students. The only difference is slightly higher values of all variables, including basic scientific literacy level and excluding student fees. This model diverts from the other models for male students in one school variable. Thus, for scientific literacy, school factors are more significant. One more issue about all models of scientific literacy is that the basic levels among them have low variance. Thus, there are no significant differences between sexes in basic scientific literacy. In other words, scientific literacy is the only type of literacy in which the basic level is not determined by sex differences.

The best model for female students' scientific literacy is more similar to previously discussed models for female literacy in mathematics and reading than to models for male students or general models. Thus, the best model includes the basic level, the highest ISEI, the ISEIs of mothers and fathers, and the amount of funding from student fees. The key difference of models for mathematics and reading literacy is a significantly lower influence of the father's ISEI. Each additional percent of a father's ISEI adds just 1.2 scores to a female student's scientific literacy. That is less than what is added by the highest ISEI or a diminished mother's ISEI. Thus, if the highest ISEI is the mother's, the overall effect will definitely be negative. The explanatory power of the scientific literacy model for female students is the least among all the models of scientific literacy. The effect of funding education by student fees is similar to the models for female students' mathematical and reading literacy. In other words, the negative effect of private education is quite similar for female students for all types of literacy.

The best models were previously discussed, including instrumental variables. Besides not having the best explanatory power, these instrumental variables predict scientific literacy in a rather accurate way. The models with instrumental variables for all male and female students include the highest ISEI (positive effect), mothers' ISEI (negative effect), and the funding of education by student fees (negative effect). Thus, a highly educated working mother with high socio-economic status has a

positive effect on a student's education only in the case that her ISEI is the highest ISEI in the family. In other cases, the common family effect is still positive, but a mother ’s influence is negative. Why is it so? Previous studies have shown that a mother's employment is an important factor in the development of children and toddlers. Thus, if a mother is employed, a child's characteristics of development are lower than for children with an unemployed mother (Cogill et al. 1986). The reason for this difference is a mother ’s time spent with her child. In other words, work is not an issue as is, but the necessity to choose between working and family time is. Family time includes reading and playing with children, as well as a mother's homework activities (Zick, Bryant and Österbacka 2001). A mother's behavior influences her child directly during communication and common activities, and indirectly during homework activities. The key issue is that a father cannot substitute for a mother during home activities. This will have other effects on a child's growth and development (Beeghly, Bretherton and Mervis 1986). The difference is in the psycho-emotional sphere. Thus, if the mother is substituted by the father during the first two years of a child's life, his/ her psycho-emotional development will be more depressive (Crain 2015). The reason lies in the connection between mothers and their toddlers. A child's connection with their father is not as close. Some scientists suppose that this is determined by biology of the birth process. Nevertheless, a mother’s role cannot be substituted by a father’s. However, few countries, including OECD countries, provide special policies for employed mothers (Gornick, Meyers and Ross 1997). These programs are usually directed at mothers with children from the ages of 0-3 years old. Whereas, other mothers have a lack of such programs available. Returning to the results of the scientific literacy research: for all male and female students, the highest ISEI raises literacy more than a mother ’s ISEI reduces it. Thus, children need positive employed and working behavior in their families. It is the most important factor. This behavior shows them how their current education will influence their future life. It also creates the values of knowledge and education. Simultaneously, children need a mother's time and attention. Therefore, mothers’ ISEI provides a negative effect. The bigger share of her time a mother spends at work, the smaller the share of time she spends at home with her family. Usually, higher ISEI claims more time and effort. In other words, children need their mother ’s time, attention, and support to improve scientific literacy. Female students need it, too. Whereas, their dependence on the highest family ISEI is significantly lower. A female student ’s scientific literacy has a slight dependence on the highest family ISEI, and her family's socio-economic family status does not motivate her very much. A mother ’s employment also affects female students negatively, but this effect is less than for male students. In other words, girls need less of their mother ’s time, attention, and support, than boys during their scientific literacy improvement. Undoubtedly, all children need it, therefore there is a minus before a mother's ISEI. Moreover, female students need a father's positive socio-economic behavior, including education, occupation status, and employment. There is not a very high coefficient before this variable, but the significance according to t-statistics is high. In other words, it is important for female students. In general, all students ' scientific literacy does not depend on a father ’s ISEI directly. Thus, for female students, a father's positive socio-economic and employment behavior are important. Male students are not as susceptible to it. The scientific literacy of students of both sexes is negatively influenced by share of private funding schools. However, female students are more susceptible to it.

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Mathematical, reading and scientific literacy are characterized by the models of two types. The first type is appropriate for all male students, whereas the second type is more appropriate for female students. For different types of literacy, explanatory variables can be similar to, or diversified from, each other. Thus, mathematical literacy for all male students depends on the highest ISEI and mother's ISEI. Whereas, for female students, it depends on the highest ISEI, mother's ISEI, father's ISEI, and share of the schools' funding by student fees. For male students, a mother's ISEI provides a bit more of a negative effect than that for all students. The highest ISEI provides a bit more of a positive effect. For female students, the highest ISEI provides a rather moderate effect, and a mother's ISEI holds almost two times less weight than for male students. The most important factor for a female student's mathematical literacy is a father's ISEI. It influences them positively. The explanatory variable, equal for female students and for all types of knowledge literacy, is the share of school's funding by student fees. The influence of this factor is equal for all the models of knowledge literacy accurate to the meaning. The model for female students has the lowest explanatory power among mathematical literacy models. However, the basic level of knowledge is not lower than in the model for male students. Thus, the basic level of mathematical literacy is not determined by sex.

Reading literacy for male students depends on the highest ISEI and mother's ISEI. The negative effect of a mother's ISEI is less than the positive effect of the highest one. In other words, a high family socioeconomic status is more important for reading literacy improvement than a mother's time and attention. In other words, if the mother is the only employed person in the family, or her ISEI is higher than the father's, she should work. It will affect a child's literacy more positively than spending her time at home. For female students, reading literacy depends on the highest ISEI, mother's ISEI, father's ISEI, and share of school's funding by student fees. For female students, each additional point of the highest ISEI adds less than it would for male students. A similar effect is observed for a mother's ISEI. The father's ISEI is the most significant factor for a female student's reading literacy. It is higher than the negative effect of a mother's ISEI. In other words, a father's socioeconomic status is the most important factor in the reading literacy development of female students. A father's behavior influences a female student more than a mother's. Thus, female students need a positive example of their father's socio-economic behavior, which stimulates them to study harder. Simultaneously, they need less of a mother's control and support. Moreover, their literacy slightly depends on family socioeconomic status. Thus, a father's behavior is more important than overall family income or welfare. The model for male students has the least explanatory power among all models for reading literacy in students. Moreover, reading literacy is the only type of literacy among the knowledge types with significant diversity in the basic level between both sexes. Boys have a significantly lower basic level of reading literacy than girls.

The models for the scientific literacy of all male and female students have a negative correlation with the share of the school's funding by student fees. Thus, scientific literacy is the only type of literacy for which all models depend on this variable, not only the model for female students. In other words, a low share of private school is more important for scientific literacy than for other types of literacy. Moreover, scientific literacy is the only type of literacy with quite a similar basic level for all models. The dependence of scientific literacy on other variables is quite typical for knowledge literacy models. The most significant difference is the influence of a quite low father's ISEI on a female student's literacy. Thus, female students need a mother's attention, time, care, and support

most of all for improving their scientific literacy.

Thus, the models for different types of knowledge literacy have a quite similar structure. The models for mathematical and reading skills are diverse only in the meaning of their coefficients. The structure of the models for mathematical, reading and scientific literacy is similar in family factors. The only significant difference for family factors is that a father's ISEI for the scientific literacy of female students is virtually less important than for mathematical or reading literacy. Moreover, the models for knowledge types of literacy are similar to each other, taking into account gender diversities.

The typical model for male students includes the highest ISEI (positive influence) and mother's ISEI (negative influence). The highest ISEI provides a bigger effect than a mother's. Thus, male students need their mother's time, care, and support to develop in school subjects. This is reflected in their mathematical, reading, and scientific literacy. The most important factor of high academic results in these fields is family socioeconomic status. The highest ISEI determines this. It does not matter if the mother or father provides this status. For scientific literacy determination, the share of the school's funding by student fees is also important. The more this share becomes, the lower scientific literacy scores become. As it was previously mentioned, this dependence is explained by lower educational standards in private schools. The absence of such standards leads to lower academic levels in some students. In other words, there is not enough internal regulation in private schools. Moreover, as S. Levitt has shown in his book, higher salaries attract a higher number of dishonest teachers, which leads to lower academic results from their students. (Levitt and Dubner 2014) For scientific literacy, a high share of private schools is more important than for reading or mathematical literacy. Mathematical and reading literacy are more explicit than scientific literacy. Thus, scientific school subjects are quite variable; they assume many different things, theories, and experiments. As a result, private schools have the opportunity to vary their teaching methods of these subjects, more so than literature or mathematics, due to more variability and necessity for experiments in scientific school subjects. The typical model for all students is similar to the model for male students. The only difference is that the coefficients before family variables are slightly less in the common model. This is explained by the role of female students that decreases coefficients in the common model in comparison with model for male students.

The typical model for female students differs. It includes the highest ISEI, mother's ISEI, father's ISEI, and share of school's funding by student fees. For mathematical and reading literacy, the highest ISEI provides quite a slight effect, whereas the mother's ISEI has a moderate effect, and the father's ISEI has the most important. In other words, female students are less dependent on family socioeconomic status and moderately depend on a mother's time, care, and support. These are still important factors, but less so than for male students. On the other hand, they significantly depend on a father's socio-economic behavior. Female students need a father's positive example for forming the internal motivation for education. They need family socio-economic status significantly less than a father's positive example. The only exclusion is the model for scientific literacy where a father's ISEI is not as important. Perhaps, the reason is in the clearer connection of a father's employment, educational and socioeconomic status with mathematical and reading literacy. However, a mother's role for all types of knowledge literacy is equal. Female students need a mother's time, care, and

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support, but their necessity is lower than that of male students. Funding education by student fees has a bigger influence on female students. Thus, their academic achievements are poor if there is plenty of private schooling. Why is it so? It is probable that female students prefer communication as a form of obtaining knowledge more than male students (Rodgers and Thorson 2003). In private schools, the educational community differs from public schools. Moreover, in private schools, education is less popular as a topic of communication than in government schools, which contributes to lower academic results for female students.

Thus, the best models for females, including instrumental variables, are quite different from the models for all students or male students. Many hypotheses can be discussed here. However, the most reasonable among these could be the hypothesis that a male student's social group is more homogeneous, while a female student's social group includes several internal clusters. For instance, one cluster of female students may prefer a social model directed at careers, whereas another may be directed at future family development. Thus, female students are quite diverse from one another, and their social groups require future additional analysis. During the combination of the likely homogeneous male students' group and heterogeneous female students' group, the common result is closer to the male group due to its internal statistical characteristics.

5. CONCLUSION

In models for all students, female and male students, scientific literacy negatively correlates with the share of schools funding by student fees. Thus, scientific literacy is the only type of literacy for which all models depend on this variable, not only the model for female students. In other words, a low share of private schools is important for scientific literacy more so than for other types of literacy. Mathematical and reading literacy for all students and male students depends on the highest ISEI and the mother's ISEI. Whereas, for female students, it depends on the highest ISEI, mother's ISEI, father's ISEI, and the share of schools funding by student fees. For male students, a mother's ISEI provides a bit more of a negative effect than for all students, combined. As far as the highest ISEI, it provides a slightly more positive effect. For female students, the highest ISEI provides a rather moderate effect, and the mother's ISEI is almost two times less weight than for male students. The most important factor for a female student's mathematical literacy is the father's ISEI, which has a positive influence. The explanatory variable which is equal for all female students for all types of literacy is the share of schools funding by student fees. The influence of this factor is equal for all the models of literacy accurate to the meaning. The model for female students has the lowest explanatory power among mathematical literacy models. However, the basic level of knowledge is not lower than in the model for male students. Thus, the basic level of mathematical literacy is not determined by sex. However, boys have a significantly lower basic level of reading literacy than girls.

6. AVAILABILITY OF DATA AND MATERIAL

The research is based on the opened PISA data. All generated data is included in this article.

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