GENDER STEREOTYPES IN THE 5TH GRADE MATHEMATICS TEACHING MATERIALS

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Abstract. *Gender equality remains one of the most relevant and therefore most often discussed research subjects. Women's rights and opportunities for self-realization have expanded significantly in recent decades; however, gender discrimination is still encountered in nowadays culture. Various studies show stereotype threat as being one of the undeniable factors for shaping stereotype-based worldview. It is proven that any representation of gender in purely traditional roles not only shapes students' understanding of abilities and interests of their gender but also has a negative impact on tests' results of a negatively stereotyped group. The object of this study is to evaluate the content of mathematics teaching material used in Lithuanian high schools, and the aim is to investigate the manifestations of stereotyping threats in educational books with qualitative content analysis using an author's evaluation matrix. The article presents results that reflect stereotype threat in mathematics teaching materials for Lithuanian fifth grade students.*
Keywords: gender equality; gender stereotypes; mathematics teaching materials.

Introduction

It is one of the priorities of today's world to ensure equal opportunities for every individual. Equal rights for everyone no matter their race, gender, religion or sexual orientation ensure moral justice. Gender equality focused on equal treatment is stated as one of core priorities of European Union (Directorate-General for Justice and Consumers, 2018). Historically, females are having more opportunities than ever before; therefore, it might seem that gender inequality is a thing of the past. In Lithuania, non-government women's organizations, the gender studies centers, municipalities and other relevant bodies are encouraged to be a part of different projects that are orientated towards reducing gender inequality. Such activities are all part of the fourth National Program on Equal Opportunities for Women and Men 2015–2021 and its Action Plan, they are coordinated by commission on Equal Opportunities for Women and Men and overseen by the Office of the Equal Opportunities Ombudsperson. However, statistics show goal for equality is yet to be achieved (Statistics Lithuania, 2018).

European Institute for Gender Equality data shows the Gender Equality Index in Lithuania in the year 2019 to be 55.5, European Union average being 67.4 (European Institute for Gender Equality, 2019). Apporximately 35% of women have college or university degree while the percentage amongst men is only 26.5%. Also, from 2010 till 2017 women unemployment rate was always lower than men (Statistics Lithuania, 2018). Despite these facts, on average, working women are paid less than men. Same data shows women salary in the year 2017 to be on average 772.5 euros monthly while men on average are paid 910.1 euros monthly. It is also known that women tend not to choose high-paying careers that are related to financial acumen and/or mathematical, logical skills.

Seeking for gender equality does not mean ignoring biological differences and stating that men are the same as women or visa versa. As defined by United Nations Population Fund, "gender equality does not mean that men and women become the same; only that access to opportunities and life changes is neither dependent on, nor constrained by, their sex" (United Nations Population Fund, 2005). Gender is a social category and, therefore, gender roles are merely a social construct. It is important to state that the harm of streotypical gender roles is that it emphasizes not biological but rather social differences. There is no denying that gender stereotypes contribute to gender inequality (Gender Equality Commission, 2014). Overgeneralized beliefs about women tend to put then in an unfavorable position. For example, women are often portrayed as being better suited for social sciences whereas men are better at exact sciences (Cavanagh, 2008).

Every topic-related research shows gender stereotypes to be harmful. There is no denying that disadvantageous expectations of stereotype-sensitive people cause them to perform worse (Schmander, 2002; Shaffer, Marx, & Prislin, 2012; Van Loo & Rydell, 2013; Casad, Hale, & Wachs, 2017). Gender stereotypes are often directed towards women and knowing those stereotypes may limit natural capabilities and prevent from fulfilling their potential.

Stereotypes are harmful for everyone no matter the age. However, the damage is significantly greater for children and teenagers because they are more sensitive towards prejudice and public opinion (Bauer & Coyne, 1997). Therefore, prejudice towards traditional gender roles (Kachel, Steffens, & Niedlich, 2016; Perrone, Wright, & Jackson, 2009) have to be avoided in teaching materials used at schools.

One may assume stereotype-based learning is not significantly harmful as it shows real life tendencies. For example, women knit more often than men and men more often than women fix cars. However, this portrayal of gender mostly in traditional roles may imply certain expectations towards one's gender. Seeing stereotypical gender roles in teaching materials make pupils believe that these are societal norms and they have to identify with the formulated opinion of public expectations (Cavanagh, 2008).

The issues mentioned above are important not only globally but also in Lithuania. It is undoubtedly important to analyze the presentation of gender roles in teaching materials for the first year of high school as the timing is also considered to be a turning point in children's lives (Žukauskienė, 2002).

The aim of the research is to evaluate contextual content of mathematics teaching materials for the 5th graders of Lithuania in order to explore gender stereotypes.

Literature review

Ahead of time assumptions about gender-related advantages or disadvantages might cause those assumptions to be confirmed. The phenomenon when members of stereotyped groups worry about their performance confirming negative stereotypes is called the stereotype threat (Steele & Aronson, 1995). In other words, believing to be unable to succeed in exact sciences or to be less capable of solving various logical tasks causes women to perform worse. For this reason, the stereotype threat is enabled not only due to public opinion but is also tied to personal beliefs.

In 1999, the stereotype threat effect on women was researched (Spencer, Steele, & Quinn, 1999). Researchers concluded women to be undeniably affected as they performed worse due to the stereotype threat. More than a decade later, other researchers examined whether feeling powerful can eliminate the deleterious effect of the stereotype threat on women's math performance by evaluating their working memory capacity (Van Loo & Rydell, 2013). They conclude the research by stating that feeling powerful helps women perform better despite the challenging situation and stereotypical statement about men having an advantage. All the women who participated in this study claimed to feel vulnerable as they were afraid to confirm negative stereotypes with their results; however, the impact on women who were feeling powerful was minor. Researchers suggest motivating women in order to reduce the effect of the stereotype threat.

The research conducted in 2012 was directed towards vulnerability of the stereotype threat regarding women's perception of their abilities in fields of science, technology, engineering and mathematics (STEM) (Shaffer et al., 2012). The study focused on the group-based approach of women while many other researchers tend to pay attention to individual approach. Results revealed that women performed worse than men when in threat-based conditions. Men were not impacted by any given stereotype threat conditions. Moreover, women who were presented with information that highlighted men's abilities and their alleged superiority in STEM were not interested in rebutting the stereotype and imagined to be almost incapable of changing this attitude by their results.

Following study might be the most important for our research as it is directed towards the stereotype threat effect on school-aged girls. Researchers studied how the stereotype threat conditions impact girls (Casad et al., 2017). They noted that while the effects of stereotype threat on adult women are well-documented, almost no such study focused on adolescent girls. Close to five hundred students from standard and honors math classes participated in this study with gender identity as a moderator. Results of this experiment show that girls underperform when informed about gender differences and alleged superiority of boys. The study also confirms that to be vulnerable to the stereotype threat, one must be a member of a stigmatized group and identify with a task or domain of tasks about which a stereotype refers as boys were not impacted by any manipulation of presenting the information.

B.J. Casad, P. Hale and F.L. Wachs (2017) also note that learning environment including teaching materials and the attitudes of teachers (and their assistants) has an impact on students. Therefore, the researchers encourage to carefully assess learning environment and to use any possible interventions to reduce the impact of gender-specific stereotypes.

Taking everything into consideration, the way that knowledge is presented has an impact on the results of the participants. It is implied that students learn not only what is taught directly but also the context of given study material. Presenting a gender in purely traditional roles shapes students' perception of their abilities. Therefore, the presentation of information in teaching materials has to remain as gender-balanced as possible.

Methodology

The material for this study was chosen regarding the teaching materials used in Lithuanian schools. Four textbooks, two task books as well as one test book were chosen for this analysis (Ališauskas, Janušaitienė, Arefjeva, & Daukšytė-Koncevičienė, 2016a, 2016b; Borkevičius, 1997; Butkevičienė, Knyvienė, Sičiūnienė, Stričkienė, Stundžienė, & Vanagas, 2005a, 2005b; Butkevičienė, Stundžienė, & Vanagas, 2011; Cibulskaitė, 2005; Sičiūnienė, 2018; Sičiūnienė, Gecevičiūtė, Radavičienė, & Rudienė, 2008a, 2008b).

Qualitative methods were chosen in order to evaluate the context of mathematical problems found in teaching materials for the 5th graders. For this study, the content analysis was chosen as a research method because of its suitability for pattern examination in selected materials.

Every problem was evaluated according to their expression and their topics. Firstly, it was determined whether a problem is eligible for categorisation. Five types of problems were decided to be uncategorizable: problems without a context (simple equations without any context), problems about animals, problems based

on data (heights, weights etc.), problems based on a family or group activity (mixed gender) and problems, where a gender cannot be determined because of plurality.

In order to use the context analysis, evaluation matrix based on researched problems was created and used as a research instrument. Therefore, if a problem was considered to be appropriate for categorisation, then it was categorised based on its topic. Throughout analysis led every problem to be looked into for the topic indication. Not only numbered problems but also prefaces of study units as well as illustrations of problems were put into consideration the same way numbered problems were. Altogether nearly six thousand problems were analysed. Based on the indication, each topic in problem was categorised. There might have been more than one topic in a problem. Categories together with indicators are shown in Table 1. This research instrument was aimed at calculating categorical distribution of topics depending on the gender.

*Table 1 **Categories and indicators***

Category	Indicators
Skillfulness	Professions: builder, electrician, baker etc.
	Repairs, installations etc.
	Making of essential items
	Yard work: plowing, fruit picking etc.
Movement	Transportation: by car, by train, by bus, by bike
	Walking, travelling by feet
	Flying
	Sailing, boating
Leisure	After school activities
	Socialisation, communication
	Mushroom picking
	Organising parties, contests etc.
Sagacity	Figures: drawing, folding, cutting out, coloring etc.
	Data: collecting, representing etc
	Solving mathematical and logical problems
	Doing puzzles, competing at competitions
	Doing homework
	Classwork (lessons at school)
Housework	Looking after flowers, putting them in vases etc.
	Profession-unrelated sewing, knitting
	Profession-unrelated housekeeping
	Profession-unrelated cooking
	Eating
Shopping	
Sports	Psychical education class activities
	Sports clubs
	Fishing
	Active leisure, hiking

Calculation was conducted in the following way. An individual topic means one point in a category. As mentioned before, one problem could mean more than one topic, therefore, more than one point. However, the number of people that are mentioned in problem does not matter. For example, if four boys are playing together, it means one topic and, therefore, one point towards category it fits best. However, if a boy plays together with a girl, a problem is considered to be uncategorizable. This simple computation let patterns and tendencies to be seen.

Research results

During the detailed analysis of selected mathematics teaching materials almost six thousand problems found in 10 study books were assessed for eligibility of categorisation and categorised if considered appropriate.

Categorical distribution of analyzed contexts is given in Figure 1. One in four topics is considered to belong to the sagacity category which makes it the most abundant category. Leisure category together with the housework category were the least abundant among categories. Most typical examples are given together with description of each category.
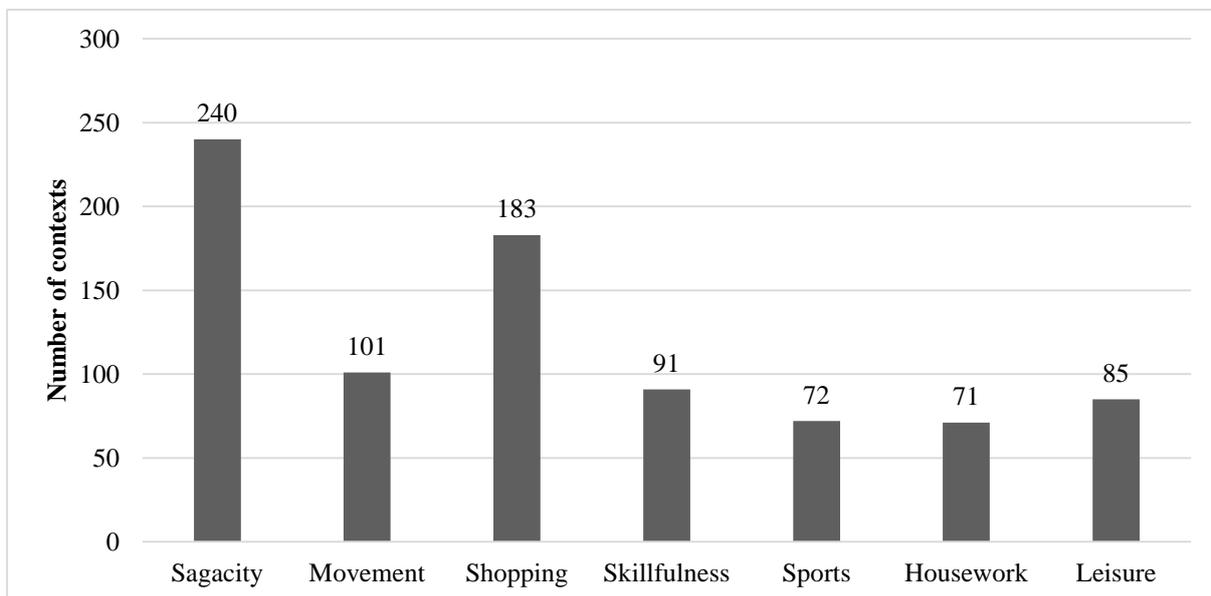
*Figure 1 **Categorical distribution***

Sagacity. Females are mentioned in this category two times less compared to males. Males are portrayed as having money more often than females and the amount of money they have is usually bigger. Exclusively men are shown to be disposing money. Only men take loans, get financing, perform banking operations, work to get paid. There are no problems that are centered on around

women disposing money in any way. Also, whenever females are shown to be working, earning money is out of the question. However, in several cases males are portrayed wondering about getting a job because of desire to earn money.

In mathematical context, males are portrayed as being curious, constantly analyzing their surroundings, noticing recurrences etc. For example, once, little boy is portayed wondering about solving unknown equations, in other example, school aged boy is figuring out addition of fractions by himself. Boys are often shown to be involved in mathematical activities because of their interests; however, girls solve mathematical or logical problems mostly in the classroom. Even formulations of problems supposedly shows male superiority because females often "try" to find out the answer to a problem whereas men "do" tasks or have already did them. In many cases, female perform easier tasks, seek solutions to more basic problems. Also worth noting is the fact, that help solving mathematical or logical problems is often provided by male characters. For example, Kipras helps his brother solve equation, boys help girls by explaning division, and adult aunt asks her nephew to help her with taxes.

Movement. Males are mentioned in this category more than two times more than females. Even though driving a vehicle is very common among mathematical problems, out of all problems woman drove a car only once and rode a bike twice. Males are portrayed driving vehicles constantly. Males drive not only cars, but also trucks, motorbikes, busses. As for many cases in this category, women use transportation but are not in charge of operating it.

Shopping. Males and females are mentioned in this category almost the same amount of times. In the shopping category, both males and females are mostly school-aged boys and girls. Both boys and girls often buy school supplies and snacks. Boys also buy household items needed for repairs such as paint or nails and girls buy household items needed for home decor and groceries for cooking. Shopping topics are tied to stereotypes found in contexts of other categories.

Skillfulness. Males are mentioned in this category two times more than females. A profession is the most frequently mentioned amongst the topics. Males are portrayed as having more opportunities and a wider range of professions available as they take part not only in masculine professions but also work as bakers, teachers etc. Men are shown working as drivers, pilots, beekeepers, gardeners, salesmen, farmers, fishermen, painters, builders, fabric workers etc. However, females are shown to be having only traditionally feminine careers, for example, bakers, teachers, needlewomen, ceramicists, florists, saleswomen, secretaries, and waiters.

Males often take part in activities that require physical strength, stamina and/or particular skills. For example, men are reparing broken things, making household improvements, making furniture etc. In researched teaching materials, females are portrayed as not having any skills or physical capabilities that would

let them make any useful items or repair something. Women are portrayed as helpless as they can only plan improvements and then seek for help to implement them. For example, females are shown planning on getting help improving household or organising various tasks to achieve desired upgrades.

Sports. Males are dominant in this category. Three out of four topics in this category belong to males. When males compete with females, males are shown to win; they are portrayed as better, faster and stronger. Males also participate in a wider variety of sports activities compared to females. There are no topics of females rowing, playing sports games for fun, shooting or competing for medals. However, males are portrayed playing many sports games including basketball, football, etc., they also compete in arm wrestling, shooting, skating, swimming championships. Whenever males and females participate in same activity, men are dominant. For example, boys run faster than girls in a competition. It is also worth mentioning than only males are shown to choose sports activities as a way to spend their freetime.

Housework. Housework category is dominated by female acts. Almost three out of four topics show females being involved in housework. Women are portrayed as housekeepers doing stereotypically feminine tasks such as cooking, taking care of plants, sewing, weaving, knitting, taking care of children. Almost every topic of a male character is him eating something.
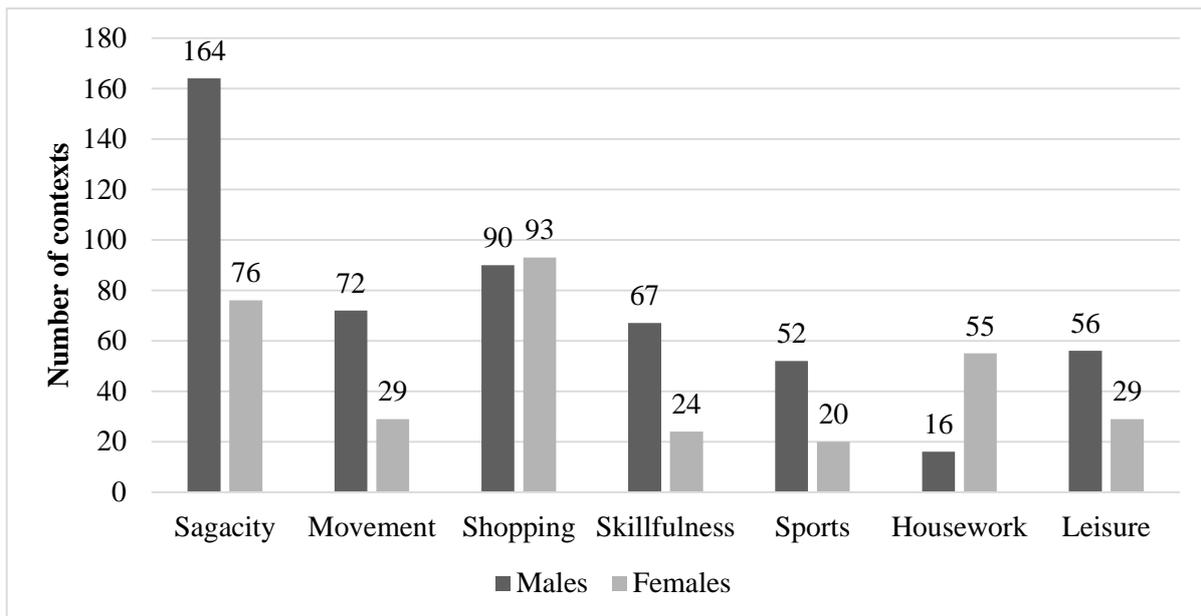
*Figure 2 **Categorical distribution regarding gender***

Leisure. Females are portrayed socializing or enjoying free time almost two times less than males. Males are shown being interested in socializing,

vacationing, researching information about cars, collecting various things. Females are portayed mostly hanging out with girlfriends, reading books etc.

Categorical distribution of analyzed contexts regarding gender is given in Figure 2. Altogether 843 problems (together with prefixes) were taken into account. It clearly shows male dominance in almost every category except housework, which is streotipicaly feminine.

Discussion

Despite women being better educated than men and working more, on average, in Lithuania men earn more than 15 percent than women. Women tend not to choose high-paying careers that are related to financial acumen and/or mathematical, logical skills.

Mathematics teaching materials for Lithuania's fifth graders were chosen to be researched in order to evaluate the stereotype threat in the context of ensuring equality between genders. The stereotypical worldview was found to be the basis of mathematical problems in all the study books.

In June 2015, European Parliament adopted a resolution (European Parliament, 2015) on the EU strategy for equality between women and men. This resolution states, that gender segregation is still practiced in many educational institutions. It also points to importance teaching materials have on pupils' worldview (Gender Equality Commission, 2014).

There is no denying the damaging effect of stereotype threat for a stereotype-sensitive group, in this case, females. The stereotype threat affects females of all ages and has to be avoided whenever possible, especially when one gender is portrayed to be advantageous in some context. It is also important to emphasize that adolescent girls are even more sensitive towards prejudice and public opinion so are even more vulnerable to stereotype threats.

The stereotype-based contextual content of teaching materials poses to be a threat of stereotypes to remain. There can be no further ignorance towards stereotype-based gender roles in teaching materials. Therefore, we would recommend that a group of professionals, including mathematicians-scientists, scientists of mathematical didactics, mathematics teachers and educologists should discuss context of all sorts of teaching materials such as textbooks, task books etc., consider importance of gender depiction and create standards for authors of teaching materials. Psychologists with children development expertise should also be involved in this discussion so there would be no harm done when depicting genders in teaching materials.

As big as this issue is, the first step may be for textbooks reviewers to be obliged to consider gender depiction when revising new teaching materials and to be able to demand for changes to be made by authors whenever necessary.

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