

## Implications of Gender in Children's Mathematics: A Systematic Review

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**Abstract:** This paper reports the use of a systematic review to explore the impact of gender in children's achievement and their skills in mathematics. The review process identified 6 key papers within the lastest five years (2010-2015). An in-depth analysis of these indicated that there was some evidence that there is a significant difference in children's mathematical achievements due to gender. The analysis also found that boys have better math skills compare than girls. These findings very important becuase has led to some improvement in children confidence and competence in mathematics. However, the analysis also highlighted some future search to be studied.

**Key words:** Gender • Mathematics • Children • Skills • Achievement

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### INTRODUCTION

Mathematical development is always parallel with the development of human civilization itself. According to [1], the math is very relevant to the demands of daily life. Mathematics is considered a form of art and beauty as well as an effective communication tool. In the era of globalization, the world is dominated by science and technology with a strong focus on the mastery of mathematics. Mathematics learning and achievement is one area of research that has gained momentum in recent years because of its importance as a subject in the school curriculum and its usefulness as a prerequisite for developing the quantitative and analytical skills. Undeniably, achievement in the field of mathematics is a very important national agenda which affects all levels of education starting from preschool till the tertiary level.

Children's poor performance in mathematics is very clear because statistics show that more than 100,000 primary school students in Malaysia do not master in reading, writing and math today. The students with poor academic achievement in the base years were also will struggle to obtain higher math skills in later years. In fact, it led to two major issues related to mathematics, namely the issue of children's mathematics achievement and the difficulty faced by the children in math's. Therefore,

mathematics began to become an issue that is always a concern and is often discussed in the media although there have been empirical studies carried out by researchers in this field [2]. Many researchers in this field believe mathematics achievement should be given serious attention as the issue of students who have difficulties in mathematics are also more serious [3,4,5,6,7,8, 9]. At the same time the issue of the factors that contribute to the achievement and the difficulty of mathematics is no less impressive say. Thus, the factors that affect mathematics achievement of these children?

Gender is one of the factors that has always been considered as an important factor as a determining of mathematics achievement and the difficulty of children to master mathematics. Boys are more mathematically oriented than girls. On the other hand girls have lower motivation when it comes to math skills [10] and the achievement of their less successful in math tests than boys [11]. The question is whether this gender factors actually affect and absolutely do not correlate with math skills of these children. More studies conducted in the United States shows that there are no gender differences in math scores and grade of middle school students and high school students [12, 13] while others started to provide evidence that it is actually children by category of boys facing problems of academic performance [14,15].

These findings contradict the stereotype that girls are inferior in ability mathematical equations and supported the hypothesis [16] - that men and women are mostly but not all the same in terms of psychological variables.

Throughout the 21st century, studies conducted in Australia, England, Hong Kong, New Zealand, Pakistan and other countries around the world generally shows that girls perform better than boys in math in the school [17,18,19, 20, 21, 22] and concerns about the boys back in schools continue to shape the discourse of education [23]. Contrary to [24], on examines the relationship between mathematical problem solving achievement and associated factors among high school students found that male students scored higher in mathematics. In fact, many studies in the UK reported that the boys 'behavior' had acted as a barrier to progress for both boys and girls in school [25, 26]. If viewed more closely study that began in 1990 until 2009 there are a conflict with the findings related to the gender factor.

One more interesting issues about gender and mathematics performance are what parents and teachers believe about their boys and girls ability in mathematics. Parents believe that their sons' mathematical ability is higher than their daughters'. In one study, fathers estimated their sons' mathematical "IQ" at 110 on average and their daughters' at 98. Meanwhile, mothers estimated 110 for sons and 104 for daughters [27, 28]. Teachers, too, tend to stereotype mathematics as a male domain. In particular, they over rate boys' ability relative to girls' [29, 30].

Other than that, The UPMAP project (Understanding Participation in Mathematics and Physics) surveyed nearly 11,000 year 8 (age 13) and year 10 (age 15) students from 133 English schools during the academic year 2008-2009 and considered enjoyment through a range of questions related to mathematics lessons and mathematics teachers [31]. They used multilevel modelling to find the contribution of any one variable while controlling for others. Students' intentions to continue with mathematics were significantly associated with high scores on perceptions of mathematics lessons, emotional response to mathematics lessons and perceptions of mathematics teachers (alongside extrinsic material gain and encouragement by family which I discuss in sections 5 and 9).

Boys scored higher than girls in their perceptions and emotional response to mathematics lessons, with small effect sizes of 0.15 and 0.09 respectively and there was no difference overall in their perceptions of teachers.

Year 10 students had more negative perceptions than younger students. Although the effect size by gender alone is very small, a feature of this research is its comparison of effect sizes across all four subgroups of boys/girls (B/G) with high/low (H/L) mathematics aspirations. Separating by subgroups showed medium effects of subgroup membership on the two enjoyment indicators (0.42 for perceptions and 0.28 for emotional response), showing that enjoyment is even more important for mathematics aspirations for girls than it is for boys. The highest means for both are for high mathematics aspiration boys (HB) and the lowest for low aspiration girls (LG): HB>HG>LB>LG.

Some studies show girls to master math while there are studies that prove the girls are more competent in mathematics. Some even found no gender differences in math skills of these children. Finally, this paper aims to see how the findings related to gender from 2010 to 2016. The objective of this study was to explore whether there is a significant change between boys and girls in terms of their ability in mastering mathematics.

**Research Methodology:** Identifying relevant studies involved carrying out an electronic search using keywords of bibliographic databases such as Emerald, Taylor & Franchise, Web of Sciences, Ebcobhost, Proquest, Digital Object Identifier (DOI), Science Direct. The scope of the research was limited to publications dated 2010 or later and focussed on gender and mathematics achievement and skills. This process applied in two stages. The first stage of filtering was based on a consideration of titles and keyword, where available, an abstract, which resulted in 51 papers being listed as possibly relevant. Keyword search which is gender, mathematics achievement, the difficulty of math, kids math and math. The second stage involved applying the inclusion/exclusion criteria to a full copy of each of these papers, which resulted in 6 papers being identified for the in-depth analysis.

## RESULTS AND DISCUSSIONS

This section discusses the analysis of systematic review. The analysis was performed only six articles were selected and comply with the objectives of this study (see Table 1). To better understand how this study has to do with the purpose of this paper is a study of their findings should be discussed in more detail.

Table 1: Six Articles From 2010 to 2016 About Gender and Mathematics

Researchers	Year of Studies	Title of Research
Frank H. Bezzina	2010	Investigating gender differences in mathematics performance and in self-regulated learning: An empirical study from Malta. Equality, Diversity and Inclusion
Chang, A., Sandhofer, C. M., & Brown, C. S.	2011	Gender biases in early number exposure to preschool-aged children
Majzub, R. M	2012	Preschool Children's Early Mathematics Achievement Based on Gender and Ethnicity
M, Prendergast, & J, O'Donoghue	2014	Influence of gender, single-sex and co-educational schooling on students' enjoyment and achievement in mathematics
Amy D. Goldman & Andrew M. Penner	2014	Exploring international gender differences in mathematics self-concept
Wei, T., Liu, X., & Barnard-Brak, L	2015	Gender differences in mathematics and reading trajectories among children from kindergarten to eighth grade

Firstly, studies by Frank H. Bezzina [32] involving 400 students from grade 11 (aged 14-15) attending Maltese mixed-ability schools undertook a mathematics test and responded to a questionnaire. The resulting performance and self-regulated learning SRL measures were used to answer four questions empirically. The results of empirical studies confirm that gender differences may be important sources of lead changes in student math performance and they SRL. Girls do better than boys ( $r = 0.2$ ) in mathematics and this difference is mainly due to poor performance among boys low achievement.

Secondly studies have been conducted by Chang, A *et al.* [33] determine whether boys and girls receive a number of different exposure to the language of numbers in a learning environment that is natural. The study found that the independent variables based on *t test* showed that there is a statistically significant difference in the overall percentage use figures of speech when communicating with boys than to communicate with the girls. As most mothers use an average of 9.49% using terms related to the number when communicating with boys compared to only 4.64% have a tendency when interacting with girls. More specifically, this study also found women were more likely to use cardinal numbers (as an example four crayons) in a quantity of objects when talking to boys compared with girls in their daily lives.

Meanwhile, Majzub, R. M. [34] who studied 138 preschool children from six preschools in Malaysia Ministry of Education to see variances stratified math preschool children in Malaysia in terms of gender and ethnic factors have found that the level of early childhood mathematics achievement preschoolers are the same. More specifically analysis using *t-test* and ANOVA showed that there were no significant differences in their mathematics achievement based on gender. However, there are significant differences between early mathematics achievement based on ethnicity.

Next, a study by Amy D. Goldman & Andrew M. Penner [35] provided an international perspective on mathematics with the self-concept of children toward mathematics, mathematics achievement and wish to pursue careers that involve mathematics among students in 49 countries. Using data from the Trends in International Mathematics and Science, this study shows that self-concept in mathematics is more closely related to the desire to enter the profession than mathematics itself. While gender differences in math self-concept is smaller in the most egalitarian countries. It was found that girls and boys have the self-concept in mathematics is lower and they are less interested in careers involving math. However, when viewed in detail a great change actually occurs. In 4 countries girls showed higher levels of self-concept in mathematics than boys. While in the other 21 countries, the boys have higher levels of self-concept in mathematics than girls.

Another study involving gender and achievement in mathematics is the study by M, Prendergast, & J, O'Donoghue [36]. This research investigates the influence that gender, single-sex and co-educational schooling can have on students' mathematics education in second-level Irish class-rooms. Although gender differences in mathematics education have been the subject of research for many years, recent results from PISA (Programme for International Student Assessment) show that there are still marked differences between the achievement and attitude of male and female students in Irish mathematics classrooms.

The analysis shows that there is a significant effect of group,  $F(1, 122) = 7.08$ ,  $p = .01$ . This is important because it shows that after adjusting for the effects of other variables, the excitement level experimental group had no positive statistical significant change compared with the control group of fun. The effect of gender was statistically using ANCOVA was not significant,  $F(1, 122) = 1.37$ ,  $p = 0.24$ . However, looking at the overall results for

Table 2: Findings comparison between 2010-2015 boys and girls in mathematics achievement

Number	Year of Studies	Findings ( Achievement in Mathematics)
1	2010	Girls have better performance in mathematics.
2	2011	Boys better than girls in terms of figures and cardinal numbers
3	2012	No Significant differences between boys and girls in mathematics achievement
4	2014	Boys showed higher enjoyable and self-concepts in mathematics compare with girls
5	2015	Boys showed a faster rate of growth mathematically.

the four schools showed some interesting findings regarding gender and mathematics. In other words, boys tend to have fun in math. This is evident from the scale in which men show a higher level of excitement to math than girls. T- test results independent variables found that there was a statistically significant difference between the scores of boys and girls in four of the five scale. The only scale that is not statistically significant Post-Expression Scale Revised excitement, where men still have higher mean (M: 27.76, SD: 10:34) than females (M: 25.47, SD: 10.01).

The latest study is the study by Wei, T *et al.* [37]. This study examines the trajectory of children math and their reading achievement from kindergarten up to the eighth grade together with gender differences. The findings show that gender has a significant relationship with growth mathematical model. Boys showed a faster rate of growth in math all the time. In the meantime, the negative regression showed that the trajectory of the female gender is relatively smooth compared to boys. For growth factors to read, on the other hand, shows the boys showed a slower rate of growth than in girls.

## CONCLUSION

In conclusion the study related to gender and mathematics from 2010 until 2015 is not very significant result compared to the years before. In the last five years boys and girls achievement in mathematics in terms of performance, achievement, self-concept in mathematics, the disclosure of mathematics, mathematical models of growth and excitement of mathematics is almost the same. There is no significant difference between the sexes of children with their math skills despite differences as discussed previously in the findings of studies that have been done.

If we look at the findings of a study conducted in 2010, girls have better performance in mathematics. In 2011, however, the boys are seen to have more exposure to the language of mathematics than girls by their mothers so that boys are more likely to use figures or the number

of cardinals in their everyday conversations. In other words, we can say the boys more noticeable. Similarly, the findings in 2014, the boys have higher enjoyable scores in mathematics than girls. Even in math self-concept in most countries (21 out of 49 countries) boys showed higher child self-concept compared to only 4 countries girls have self-concept. Studies in 2015 showed the boys a faster rate of growth mathematically. While the girls their growth more smoothly.

Only one study clearly shows there is no significant difference of gender in children's early mathematics achievement. Studies in 2012 significantly declared non-existent gender differences in early mathematics achievement of preschool children in the Ministry of Education in the last survey was conducted. The findings in the last 5 years can be summarized (see Table 1):

One interesting finding is that boys demonstrate good performance and high excitement in math compare than girls. It is based on the results of the study in 2011, 2014 and 2015.

The implication of this study is the most obvious gender is a factor that must be well understood by local researchers. This is because gender distinguishes the achievements of children in mastering mathematics. Implications of the teacher can be seen from the improvement in the pedagogical aspect. Teaching techniques should be varied to suit the particular gender differences. Looking at the findings that have been discussed, there are still clearly 'gap' in gender to be studied. By that means a study involving gender is still to be seen again in future studies with more long-term focus. In fact, the empirical studies that explore the effects of gender on mathematics achievement can also be done to determine the effect more precisely.

## REFERENCES

1. Dorfler, W., 2003. Mathematics and mathematics education: Content and people, relation and differences. Educational Studies in Mathematic, 54, 147-170. <http://dx.doi.org/10.1023/B:EDUC.0000006118.25919.07>

2. Lyon, G.R., J.M. Fletcher, S.E. Shaywitz, B.A. Shaywitz, J.K. Torgesen, F.B. Wood and R. Olson, 2001. Rethinking learning disabilities. *Rethinking Special Education for a New Century*, pp: 259-287.
3. Clarke, B. and M.R. Shinn, 2004. A preliminary investigation into the identification and development of early mathematics curriculum-based measurement. *School Psychology Review*, 33(2): 234.
4. Malofeeva, E., J. Day, X. Saco, L. Young and D. Ciancio, 2004. Construction and Evaluation of a Number Sense Test With Head Start Children. *Journal of Educational Psychology*, 96(4): 648.
5. Mazzocco, M.M. and R.E. Thompson, 2005. Kindergarten predictors of math learning disability. *Learning Disabilities Research and Practice*, 20(3): 142-155.
6. Jordan, N.C. and S.C. Levine, 2009. Socioeconomic variation, number competence and mathematics learning difficulties in young children. *Developmental Disabilities Research Reviews*, 15(1): 60-68.
7. Jordan, N.C., D. Kaplan, L. Nabors Oláh and M.N. Locuniak, 2006. Number sense growth in kindergarten: A longitudinal investigation of children at risk for mathematics difficulties. *Child development*, 77(1): 153-175.
8. Methe, S.A., J.M. Hintze and R.G. Floyd, 2008. Validation and decision accuracy of early numeracy skill indicators. *School Psychology Review*, 37(3): 359.
9. Lembke, E. and A. Foegen, 2009. Identifying Early Numeracy Indicators for Kindergarten and First-Grade Students. *Learning Disabilities Research and Practice*, 24(1): 12-20.
10. Boehlaerts, M., G. Seegers and H. Vermeer, 1995. Solving math problems: Where and why does the solution process go astray?. *Educational Studies in Mathematics*, 28(3): 241-262.
11. Carr, M., D.L. Jessup and D. Fuller, 1999. Gender differences in first-grade mathematics strategy use: Parent and teacher contributions. *Journal for research in mathematics education*, 20-46. <http://dx.doi.org/10.2307/749628>
12. Catsambis, S., 1994. The path to math: Gender and racial-ethnic differences in mathematics participation from middle school to high school. *Sociology of Education*, pp: 199-215.
13. Hyde, J.S., S.M. Lindberg, M.C. Linn, A.B. Ellis and C.C. Williams, 2008. Gender similarities characterize math performance. *Science*, 321(5888): 494-495.
14. Kenney-Benson, G.A., E.M. Pomerantz, A.M. Ryan and H. Patrick, 2006. Sex differences in math performance: The role of children's approach to schoolwork. *Developmental Psychology*, 42(1): 11.
15. Pomerantz, E.M., E.R. Altermatt and J.L. Saxon, 2002. Making the grade but feeling distressed: Gender differences in academic performance and internal distress. *Journal of Educational Psychology*, 94(2): 396.
16. Hyde, J.S., 2005. The gender similarities hypothesis. *American psychologist*, 60(6): 581.
17. Downing, K., S.W. Chan, W.K. Downing, T. Kwong and T.F. Lam, 2008. Measuring gender differences in cognitive functioning. *Multicultural Education and Technology Journal*, 2(1): 4-18.
18. Foster, V., M. Kimmel and C. Skelton, 2001. What about the boys?. An overview of the debates. In W. Martino and B. Meyenn (Eds.), *What about the boys*, pp: 1-23.
19. Gorard, S., G. Rees and J. Salisbury, 2001. Investigating the patterns of differential attainment of boys and girls at school. *British Educational Research Journal*, 27(2): 125-139.
20. Rowe, K.J. and K.S. Rowe, 2002. What matters most: evidence-based findings on key factors affecting the educational experiences and outcomes for girls and boys throughout their primary and secondary schooling *Student Learning Processes*. See also [http://research.acer.edu.au/learning\\_processes/4](http://research.acer.edu.au/learning_processes/4)
21. Rowe, K., 2001. What Really Matters-the 'Pimple' or the 'Pumpkin'?: Exploring the Evidence for 'Real' Factors Affecting Girls' and Boys' Experiences and Outcomes of Schooling. *Boys' Education and Beyond*, Fremantle, Western Australia.
22. Saeed, M., M. Bashir Gondal and Bushra, 2005. Assessing achievement of primary grader students and factors affecting achievement in Pakistan. *International Journal of Educational Management*, 19(6): 486-499.
23. Qualifications and Curriculum Authority (QCA) 2003. *Using Assessment to Raise Achievement in Mathematics at Key Stages 1, 2 and 3*, Qualifications and Curriculum Authority, QCA Publications, London.
24. Mokhtar, I., 2000. The relationship between problem solving achievement and learning style and associated factors among secondary school students.

25. Francis, B., 1999. Lads, lasses and (new) labour: 14-16-year-old students' responses to the 'laddish behaviour and boys' underachievement' debate. *British Journal of Sociology of Education*, 20(3): 355-371.
26. Warrington, M., M. Younger and J. Williams, 2000. Student attitudes, image and the gender gap. *British Educational Research Journal*, 26(3): 393-407.
27. Furnham, A., E. Reeves and S. Budhani, 2002. Parents think their sons are brighter than their daughters: Sex differences in parental self-estimations and estimations of their children's multiple intelligences. *Journal of Genetic Psychology*, 163: 24-39.
28. Frome, P.M. and J.S. Eccles, 1998. Parents' influence on children's achievement-related perceptions. *Journal of Personality and Social Psychology*, 74: 435-452.
29. Li, Q., 1999. Teachers' beliefs and gender differences in mathematics: A review. *Educational Research*, 41(1): 63-76.
30. Helwig, R., L. Anderson and G. Tindal, 2001. Influence of elementary student gender on teachers' perceptions of mathematics achievement. *Journal of Educational Research*, 95: 93-102.
31. Mujtaba, T. and M.J. Reiss, 2013. What sort of girl wants to study physics after the age of 16? Findings from a large-scale UK survey. *International Journal of Science Education*, 35(17): 2979-2998.
32. Frank H. Bezzina, 2010. Investigating gender differences in mathematics performance and in self-regulated learning: An empirical study from Malta. *Equality, Diversity and Inclusion: An International Journal*, 29(7): 669-693.
33. Chang, A., C.M. Sandhofer and C.S. Brown, 2011. Gender biases in early number exposure to preschool-aged children. *Journal of Language and Social Psychology*, 0261927X11416207.
34. Majzub, R.M., 2012. Preschool Children's Early Mathematics Achievement Based on Gender and Ethnicity. *Asian Social Science*, 8(16), 24.
35. Amy D. Goldman and Andrew M. Penner, 2014. Exploring international gender differences in mathematics self-concept. *International Journal of Adolescence and Youth*, pp: 1-16.
36. Prendergast, M. and J. O'Donoghue, 2014. Influence of gender, single-sex and co-educational schooling on students' enjoyment and achievement in mathematics. *International Journal of Mathematical Education in Science and Technology*, 45(8): 1115-1130.
37. Wei, T., X. Liu and L. Barnard-Brak, 2015. Gender differences in mathematics and reading trajectories among children from kindergarten to eighth grade. *Research in Education*, 93(1): 77-89.