Commentary on Chapter 14

Mathematics Achievement and Gender:

A Case of "No Difference" from Turkey

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Jacobs points out the fact that culture and socioeconomic circumstances affect the mathematics education of individuals. Accordingly, girls' mathematics achievement shows some variations across different countries. Unlike popular misconceptions about the roles of males and females in Turkish society, in this commentary we will show that the majority of studies conducted in Turkey have found **no significant mean difference** between mathematics achievement of boys and girls especially in primary and high schools. Hence, we do not think we need to offer an alternate pedagogy for girls. We briefly point out some points of convergences and divergences with the Jacobs' article. And then, we give some background information on Turkish education. Subsequently, we discuss the literature related to mathematics achievement and gender in Turkey. The discussion includes the results of TIMMS, national exams in Turkey in addition to articles, theses and dissertations.

Introduction: Revisiting the Gender Debate

Gender differences in mathematics achievement are a well documented world wide phenomenon. In their recent summary of the research literature Steinthorsdottir and Sriraman (2008) found that the existing literature has examined variables such as self-efficacy and its relationship to other variables such as parent, teacher and societal expectancies, sexual stereotyping as well as differential achievement-relevant attitudes in addition to internal and external variables such as beliefs and student-teacher interactions. Another important dimension in this debate is the issue of race or class, research on which has shown that girls and children of immigrants and minority groups under achieve in mathematics (see Steinthorsdottir & Sriraman, 2008). In the UK and Australia several studies provide evidence for the “hidden” link between socio-economic class and their choices in university studies. Maslen (1995) wrote that students in their final years of compulsory schooling were twice as likely to pursue mathematics and science if they are from the higher socio-economic status bands, compared with the lower (Ernest, 2007). The literature in gender studies suggests that society as whole believes that females are less mathematically capable than men. Females are particularly vulnerable to the stereotype that “girls just can’t do math” and when women go onto courses like calculus they fare less well than men who have shown equal promise up to that point (Lubienski & Bowen, 2000).

We have chosen to focus only on achievement and gender in this chapter for a strategic reason. As indicated above one can find an entire industry of psychological studies showing differences between attitudes of males and females towards just about anything including mathematics! However we think the real issue is whether there is any "achievement" or "performance" difference between girls and boys. When there is no difference in achievement, there is no reason to discuss attitude studies in detail. Also even when there are differences in achievement, rather than studying some psychological traits, studying more structural and social issues are more important.

Feminist Pedagogy and Mathematics

Many notable feminist theoretists, including Luce Irigaray, launched an attack on “Sameness”—understanding woman in the light of what one know about man. Jacobs also challenges a basic assumption that is often found in research related to possible causes for women’s lower achievement in mathematics. According to this assumption, males are the norm and females should be more like males in order to succeed in mathematics. Jacobs’ article correctly starts with the premise that women’s perceived low performance in mathematics has nothing to do with their ability to do mathematics. Rather, the problem is that women do not want to study mathematics as it is currently taught. Although we share many of Jacobs’ observations, we differ in how she conceptualizes women’s ways of knowing. She, for instance, categorizes most women as connected knowers and men as separate knowers. This dichotomous emphasis is problematic in the teaching and learning of mathematics. We do not base our theoretical discussion on such a categorization of gendered knowing ways. We believe that in order to understand gender differences in mathematics achievement, rather than subscribing to natural abilities or gendered ways of knowing, we should take socio-cultural formations of girls and boys seriously. In other words, any difference in achievement can be attributed to prior learning, orientations and expectations of and from students.

Jacobs' feminist pedagogy virtually sees no difference between a feminist pedagogy and constructivism as an educational and epistemological framework (i.e., "In using feminist pedagogy in a mathematics classroom the instructor must balance her role as question or problem poser and source of answers, creating a more egalitarian environment than the usual mathematics class. Students need to generate their own knowledge and connect with the knowledge of other students." (p. 3). This seems to be a little bit problematical as the agenda that must be unique to feminism is male oppression. It is not clear how constructivism deals with this agenda. Constructivism to us is more or less a generic epistemological framework that provides some means and suggestions to make learning mathematics meaningful for all.

We agree that any instructor must balance her role as source of knowledge and problem poser, as suggested by Jacobs. Nonetheless, we would like to point out that we should not miss the opportunity to benefit from what Noddings has called *care ethic*. This ethics is based on the relation between the "one-caring" (carer) and the "cared-for." The one-caring is obliged to meet the needs of the cared-for and the cared-for is obliged to continue the relation by recognizing the one-caring. This caring relationship between a teacher and a student might seem to be very traditional and even might carry some forms of domination. But, the aim is not to create a form of domination, but to engage a dialogue with our students and learn more about them. By knowing more about them, as Noddings (2005) point out, as teachers we increase our own professional competence. Therefore, no matter whether we let our students construct their own knowledge or not, we should assume responsibility to learn more about our students and try to meet with their needs.

Education in Turkey

As of 2008, the estimated population of Turkey is 71.5 million (TUIK, 2008). Children between 0-14 age groups constituted 26 % or 18.7 million people. Population between 5-24 age groups constituted about 35 % or 25 million people. The primary education was compulsory education which was extended to 8 years in 1997 for children aged between 6 and 14 age groups. Secondary education was also extended to 4 years in 2005. Some demographic data is given in **Table 2** for pre-primary through secondary education and tertiary education.

Table 2. Some Demographic Data from Pre-primary through Secondary Education in 2007-2008.

	Number of Students			**Percent**	
	Total	**Female**	**Male**	**Female**	**Male**
Pre-primary	804765	383732	421033	47.68	52.32
Primary	10709920	5156871	5553871	48.15	51.86
Secondary	3837164	1 757223	2079941	45.79	54.21
Tertiary	2345887	1019509	1352627	43.46	57.66
Total	17697736	8317335	9407472	47.00	53.16

Source: MoNE, 2009; ÖSYM, 2008.

When the students graduate from high schools, they have to take the university entrance examination to be placed in a university. However, there is an exception for graduates of vocational high schools who can continue their further education in higher vocational education directly at the post-secondary vocational schools. **Table 3** shows that the number of students who are enrolled in higher education institutions and higher educational institutions enrollments by fields of study in 2003-2004.

Table 3. Higher Educational Institutions Enrollments by Fields of Study in 2003-2004.

Education Field	Number of Students			Percent	
	Total	**Female**	**Male**	**Female**	**Male**
Education	243477	129311	114166	53.11	46.89
Human sciences & art	73459	40880	32 579	55.65	44.35
Social sciences, business, law	619190	251267	367923	40.58	59.42
Positive &natural sciences	102897	40912	61985	39.76	60.24
Engineering, production and construction	113681	24555	89126	21.60	78.40
Agriculture, forestry, fishery & veterinary	33370	9187	24183	27.53	72.47
Health &social services	71429	43700	27729	61.18	38.82
Services	21366	5948	15418	27.84	72.16

Source: Turkish Statistical Institute, 2004, p. 106.

As seen in **Table 3** while there are less male students in education, human sciences and art, and health and social services fields than female students, this situation is reversed in other education fields. Also, Table 3 indicates some demographic data on employed persons who are greater than or equal to 15 age group by gender, status in employment, branch of economic activity for 2004 (Turkish Statistical Institute, 2004, p. 153). As seen in **Table 4**, while there are fewer females in all three economic activities than males, there is a big difference in industry area in favor of males.

Table 4. Demographic Data on Employed Persons by Gender, Status in Employment and Branch of Economic Activity for 2004*

	Number of Students				Percent		
	Total	**Agricul-ture**	**Industry**	**Services**	**Agricul-ture**	**Industry**	**Services**
Males	16 023	4 101	4 206	7 716	25.59	26.25	48.16
Regular Employee	7 352	91	2 746	4 515	1.24	37.35	61.41

Casual employee	1 461	245	701	516	16.77	47.98	35.32
Employer	971	92	290	588	9.47	29.87	60.56
Self employed	4 805	2 613	380	1 814	53.48	7.91	37.75
					54.38	7.91	37.75
Unpaid family worker	1 443	1 059	89	285	73.39	6.17	19.75
Females	5 768	3 299	811	1 657	57.19	14.06	28.73
Regular Employee	1 927	9	601	1 315	0.47	31.19	68.24
Casual employee	338	152	86	101	44.97	25.44	29.88
Employer	49	7	6	36	14.29	12.24	73.47
Self employed	583	427	71	86	73.24	12.18	14.75
Unpaid family worker	2 870	2 703	47	120	94.18	1.64	4.18

* Numbers should be multiplied by 1000

Gender and Mathematics Achievement in Turkey

In Turkey an implicit public opinion favoring males' superiority in achievement over females' is dominant. However, the validity of this opinion has not been empirically demonstrated (Köse, 2001). In fact, the majority of empirical studies related to achievement in mathematics resulted in no mean difference between males and females especially in primary and high school years (see **Table 5**). However, two studies on pre-service mathematics and elementary teachers showed that males are more successful than females in probability and geometry.

Table 5: Studies Conducted in Turkey related to Gender and Mathematics Achievement.

Authors	**Date**	**Subject/ Grades**	**Topics**	**Findings on Gender**
Bulut	1994	8th grade	Probability	Mean difference in achievement in favor of girls.
Ubuz	1999	10th and 11th grades	Geometry	Generally girls are more successful than boys.
Karaman	2000	6th grade	Geometry	No mean difference in plane geometry achievement.
Duatepe	2000	Pre-service elementary school teachers	Geometry	Mean difference in achievement in favor of boys.
Açıkbaş	2002	Middle School	Mathematics	No mean difference in achievement.
Bulut, Yetkin & Kazak	2002	Senior pre-service secondary education mathematics teachers	Probability	Mean difference in achievement in favor of boys.
Duru	2002	9th grade	Mathematics	No mean difference in achievement.
İsrael	2003	8th grade	Mathematics	No difference in problem solving performance.
Boz	2004	9th Grade	Estimation	No mean difference in estimation ability.
Erbas	2005	8th and 9th grade	Mathematics	No relationship between mathematics achievement and gender. No relationship between algebra achievement and gender.
Savaş & Duru	2005	9th grade	Mathematics	No mean difference in achievement.
Alkan & Bukova Güzel	2005	Pre-service mathematics teachers	Mathematics	No mean difference in mathematical thinking.
Açıkgöz	2006	8th grade	Mathematics	No mean difference in achievement.
Isiksal & Cakiroglu	2008	8th grade	Mathematics	Mean difference in achievement in favor boys. But no practical significance.
Ubuz, Üstün, & Erbaş	2009	7th grade	Geometry	No mean difference in pre and post achievement tests. Girls retained their knowledge better than boys.

Note: All mean differences and relationships are statistically tested.

Along with the majority of empirical studies mentioned above, in a comprehensive national study on over 110,000 students conducted by the Ministry of National Education in 2002 to monitor students' mathematics achievement from grade 4 through grade 8, girls' average scores were either the same with or higher than boys' average scores (EARGED, 2002) (see **Table 6**).

Table 6. Average of the Students' Achievement Scores (out of 100) by Gender.

	Girl	**Boy**
Grade 4	42	42
Grade 5	47	47
Grade 6	36	36
Grade 7	36	34
Grade 8	42	42

Source: EARGED, 2002.

In the nationwide secondary education entrance examination (SEE) for eight grade students, boys slightly outperformed girls in mathematics subsection of SEE from 2006 to 2008 according to students' average net scores (calculated using formula scoring), though gender difference was not meaningful or important (see **Table 7**).

Table 7. Students' average net scores in mathematics subsection of SEE by gender.

	Number of Students		Mean Net Scores		Standard Deviation		*Effect Size*
	Female	Male	Female	Male	Female	Male	
2008	441,323	464,532	7.05	7.41	6.675	7.045	0.05
2007	396,844	421,478	6.87	6.91	5.063	5.299	0.01
2006	383,621	416,589	5.42	5.67	4.653	4.963	0.05

Source: Unpublished data from Ministry of National Education.

Similar to national studies, international studies also found no difference in mathematics achievement across gender in Turkey. The findings from the TIMMS 1999 study on eight graders suggested that on an average across all counties that participated in the study there was a modest but significant difference favoring boys, although the situation varied considerably among countries (Mullis, et al., 2000). Turkey was among few countries which showed almost no achievement difference across gender. In the media hullabaloo that followed in North America and Western Europe about TIMMS, little or no mention was made of this astonishing fact! Turkey had 2 average scale score between girls and boys, while Bulgaria had 0, Canada 3, Finland 3, United States 7, Japan 8, and Israel 16. The TIMMS 2007 study also showed that there was almost no difference between girls and boys' scores of mathematics achievement in Turkey while there was difference in various Western and Middle Eastern countries (Martin, et al., 2008).[1] Again the Western media has made little or no mention of this remarkable fact, in contrast to the attention that was paid to the achievement scores favoring females in Iceland in PISA 2003 (see Steinthorsdottir & Sriraman, 2007).

While the majority of studies in Turkey showed no difference between boys and girls' mathematics achievement especially in primary school, there is nonetheless a slight difference in university entrance exam. From 2006 to 2008, boys entering university entrance exam (UEE) slightly outperformed girls in mathematics I test (see **Table 8**). While there is a difference between girls' average scores and boys' average scores, this difference does not have any practical significance as the effect sizes for all three years are very small (0.08, 0.02, 0.12 respectively).

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[1] In contrast to TIMMS 1999 and 2007 results, OECD's PISA 2003 showed that boys outperformed girls in mathematics (OECD, 2004). We do not discuss PISA results in this article for several reasons. First, we focus on mathematics achievement and PISA does not aim to assess academic achievement, so it does not tell much about school teaching or students learning. In other words, PISA with its "everyday life" problems provides little guidance for policy on schooling (Prais, 2003). Second, from sampling and cultural bias to response rate and translation, there are many methodological concerns related to PISA that makes PISA controversial for a cross cultural comparison (Hopmann & Brinek, 2007).

Table 8: 2006-2008 UEE Mathematics I Results by Gender.

	Boy		Girl		*Effect Size*
	Mean	Standard Deviation	Mean	Standard Deviation	
2008	8.60	8.48	7.95	7.85	0.08
2007	8.70	9.29	8.46	8.84	0.02
2006	8.83	8.77	7.81	7.91	0.12

Source: OSYM's unpublished data.

In a study on high school seniors' performance in school and scores in university entrance exam, Köse (2001) found that girls had higher level of school performance than boys but boys had higher level of mathematical achievement (numerical ability) in university entrance exam than girls. Moreover, Köse's study also indicated that "gender differences in school performance, verbal and numerical abilities are not as great as speculated throughout the literature, and significantly decreased when it was controlled by branch and father's occupational status" (p. 62). In another words, the greatest amount of variation in numerical ability was explained by father's occupational status. Thus, girls within themselves are quite heterogeneous and gender inequalities in Turkish education cannot be explained "without understanding the underlying cultural, social and economic characteristics of society" (p. 63).

With the regional disparities in Turkey, it is easy to discern unequal participation rates of girls into schools. There is a considerable difference between southeastern and northwestern Turkey in terms of development and access to education. With the Ministry of National Education's and NGO's campaigns (i.e., Hey Girls, Let's go to school!) to encourage and support families to send their daughters to the schools, girls' participation to primary and secondary schools has been increased in the last six years. Nonetheless, there is still unequal access to primary education

(ERG, 2009). In rural areas, every two out of three children who do not go to primary schools are girls. The participation rate of girls into primary schools is 21 percent is lower than that of boys. As of 2007-2008, the participation to primary schools is about 95 percent in Turkey.

It seems safe to argue that unless Turkey reaches a universal access to primary education and an equal access to secondary education, girls' access to higher education are limited. Nonetheless, once girls are able to enter into higher education programs, a significant portion of them choose to study in mathematical and natural sciences. In 2007-2008, the number of new female students in mathematics and natural sciences outweigh the number of male students, though females are less represented in technical and engineering sciences (see **Table 9**).

Table 9: Number of Undergraduate Students in 2007-2008 by Field of Study

	New Admission		Total Number of Students	
	Female	Male	Female	Male
Languages & Literature	6683	3633	28707	14697
Mathematics & Natural Sciences	12155	9286	46052	52108
Health Sciences	10606	6588	47663	36313
Social Sciences	12036	9653	47329	46875
Applied Social Sciences	44370	42221	200123	217009
Agriculture and Forestry	2833	4233	10168	19245
Technical and Engineering Sciences	11070	23790	43978	130405
Art	3065	2832	12726	11945
Total	102818	102236	436746	528597

Source: OSYM, 2008.

In almost all industrialized countries, gender differences in tertiary qualifications related to mathematics and computer science remain persistently high: "the proportion of women among university graduates in mathematics and computer science is only 30 per cent, on average, among OECD countries" (OECD, 2004, p. 96). Nonetheless, compared to women in Western countries, Turkish women seem to be relatively well represented in mathematics and physical sciences, as well as computer science programs. A study by Charles and Bradley (2006) found that extent of the difference in male-to-female ratios varies a great deal across the industrialized countries. In OECD countries, women are overrepresented in education, health and life sciences, and humanities and social sciences programs, and men are overrepresented in the mathematical and physical science category (except in Turkey). Among OECD countries, males are overrepresented among computer science graduates by a factor of 1.79 in Turkey, on the low end, to a factor of 6.42 in the Czech Republic, on the high. That is, male overrepresentation in computer science in the Czech Republic is more than three times more extreme than in Turkey. In the United States, the male overrepresentation factor is 2.10 and in the United Kingdom, 3.10. Charles and Bradley relate gender-neutral distribution across fields of study to governments' prioritization of merit (University of California, 2005). Accordingly, free choices made during adolescence are more likely to be made on the basis of gender stereotypes as the Western societies have deeply rooted cultural assumptions about gender difference that coexist alongside liberal-egalitarian principles (Charles and Bradley, 2006). Turkish university entrance examination system, on the other hand, seems to orient student to choose programs based on their score, not primarily on their likes or dislikes, as entering into higher education programs are very competitive and students are placed based on a combination of university entrance exam score and high school grades.

Moreover, many Turkish girls think that education is a key to be independent economically so that this can provide freedom for their future life. This mindset is very similar to those reported by Steinthorsdottir and Sriraman (2008) among rural girls in Iceland. Thus, Turkish females study harder in their courses and especially for the national exams. After the children finish their compulsory education, some economically disadvantaged families prefer their sons, rather than their daughters, to continue their education because of the societal roles assigned to boys in families. Also, some families think that girls do not need to continue their education, especially when they are not very successful in primary school. As a result all girls do not continue their education in high schools, so those girls who continue their education in high schools are selected by socioeconomic status and achievement. However, this does not mean that girls who do not continue their education would fail in mathematics if they were given a chance to continue their education. It is not easy for a girl graduating from primary school or high school to find a decent job; girls graduating from a college significantly increase their chance of finding a good job. Finding a job for a girl graduating from a typical high school is much easier in Europe and the US than Turkey. Accordingly, many Turkish girls believe that they cannot find jobs as much as boys. So they believe that they must be educated to have a good job. In the current Turkish national educational system, mathematics plays a crucial role in national exams. Therefore, whoever regardless of gender wants to get a good score has to study mathematics hard.

Conclusion

Although many studies in some countries showed some gender difference in mathematics, the studies have found no such difference in Turkey. One reason for this is the fact that Turkish educational system is relatively inflexible in the sense that all students at the end of primary school and high school have to take entrance exams in order to be placed in a quality school or program and mathematics is a key subject in those exams. The policy implications are paradoxical, and even opposite to the many tenets of progressive education such as letting students pursue their preferences early on. Because when girls choose their careers in the early years of schooling, they may follow their communities' gendered division of labor. In modern societies, "individual preferences are treated as sacrosanct, and there is little attention paid to the role of socialization, social exchange, and power differentials in generating gender-specific tastes and career aspirations" (Charles and Bradley, 2006, p. 197). Accordingly, we should insist on more mathematics for all students in order to minimize gendered division of career choices.

REFERENCES

Açıkbaş, N. (2002). *The relationship between mathematics performance, attitudes toward mathematics, grade level and gender.* Unpublished master's thesis, Boğaziçi University, Ankara, Turkey.

Açıkgöz, S. (2006). *Contributions of self-confidence, actual work effort and perceived importance of work effort to eight grade students' mathematics achievement.* Unpublished master's thesis, Middle East Technical University, Ankara, Turkey.

Alkan, H. & Bukova Güzel, E. (2005). Öğretmen adaylarında matematiksel düşünmenin gelişimi [The development of mathematical reasoning of preservice teachers]. *Gazi Eğitim Fakültesi Dergisi*, *25*(3), 221-236.

Boz, B. (2004). *Investigation of the computational estimation ability of high school students*. Unpublished master's thesis, Middle East Technical University, Ankara, Turkey.

Bulut, S., Yetkin, İ. E., & Kazak, S. (2002). Matematik öğretmen adaylarının olasılık başarısı, olasılık ve matematiğe yönelik tutumlarının cinsiyete göre incelenmesi [Investigation of prospective mathematics teachers' probability achievement, attitudes toward probability and mathematics with respect to gender]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 22*, 21-28.

Charles, M. & Bradley, K. (2006). A matter of degrees: Female underrepresentation in computer science programs cross-nationally. In J. M. Cohoon and W. Aspray (Eds), *Women and Information Technology: Research on the Reasons for Underrepresentation* (pp. 183-203). Cambridge, MA: MIT Press.

Duatepe, A. (2006). *An investigation on the relationship between Van Hiele geometric level of thinking and demographic variables for preservice elementary school teachers*. Unpublished master's thesis, Middle East Technical University, Ankara, Turkey.

Duru, A. (2002).Van ilindeki lise birinci sınıflarda cinsiyet farklılığının matematik başarısı üzerindeki etkisinin araştırılması [Research of affect of gender difference on mathematics achievement in first of grade high school in the city of Van, Turkey]. Unpublished master's thesis, Yuzuncuyil University, Van, Turkey.

EARGED. (2002). *ÖBBS 2002. İlköğretim öğrencilerinin başarılarının belirlenmesi. Durum belirleme raporu* [OBBS 2002. Studying the achievement of Turkish primary school students. An assessment report.]. Ankara: EARGED.

Erbas, A. K. (2005). Predicting Turkish ninth grade students' algebra performance. *The Mathematics Educator, 15*(1), 25-34.

ERG. (2009). *Egitimde esitsizlik*. Istanbul: ERG.

Ernest, P. (2007). Questioning the gender problem in mathematics. *Philosophy of Mathematics Education Journal*, no. 20.

Ergöz, G. (2008). *Investigation of self-regulated learning and motivational beliefs in mathematics achievement.* Unpublished master's thesis, Middle East Technical University, Ankara, Turkey.

Hopmann, S. T. & Brinek, G. (2007). Introduction: PISA according to PISA-Does PISA keep what it promises? In S. Hopmann, S., G. Brinek and M. Retzl (eds.), *PISA according to PISA - Does PISA keep what it promises?* (pp. 9–19) Berlin and Vienna: LIT Verlag.

Isiksal, M. & Cakiroglu, E. (2008). Gender differences regarding mathematics achievement: The case of Turkish middle school students. *School Science and Mathematics*, 108(3), 113–120.

İsrael, E. (2003). *Problem çözme stratejileri, başarı düzeyi, sosyo-ekonomik düzey ve cinsiyet ilişkileri* [Relations among problem solving strategies, achievement, socio-economic status, and gender]. Unpublished master's thesis, Dokuz Eylul University, Izmir, Turkey.

Karaman, T. (2000). *The Relationship between gender, spatial visualization, spatial orientation , flexibility of closure abilities and the performances related to plane geometry subject of the sixth grade students.* Unpublished master's thesis, Boğaziçi University, Istanbul, Turkey.

Köse, M. R. (2001). Gender, branch and father's occupational-status-based variations in school performance, verbal and numerical abilities of high school seniors in Ankara. *Bogazici University Journal of Education*, *18*(1), 49-67.

Lubienski, S. T. & Bowen, A. (2000). Who’s counting? A survey of mathematics education research 1982-1998. *Journal for research in mathematics education*, 31, 626-633.

Martin, M. O., et al. (2008). *TIMMS 2007 international mathematics report*. Boston: IEA TIMMS & PIRLS International Study Center.

Maslen, G. (1995) Posh boys and girls choose physics, *The Times Educational Supplement*, 27 January: 15.

MoNE. (2009). *National education statistics formal education 2007-2008*. Ankara: MoNE.

Mullis, I. V. S., et al. (2000). *TIMMS 1999 international mathematics report*. Boston: The International Study Center.

Noddings, N. (2005). Caring in education. *The Encyclopedia of Informal Education*. Retrieved April 29, 2009, from http://www.infed.org/biblio/noddings_caring_in_education.htm

OECD. (2004). *Learning for tomorrow’s world – First results from PISA 2003*. Paris: OECD.

OSYM. (2008). *2007-2008 öğretim yılı yükseköğretim istatistikleri* [2007-2008 Higher education statistics]. Ankara: ÖSYM.

Prais, S. J. (2003). Cautions on OECD's recent educational survey (PISA). *Oxford Review of Education*, *29*(2), 139-163.

Savaş, E. & Duru, A. (2005). Gender differences in mathematics achievement and attitude towards mathematics among first grade of high school (abstract). *Eurasian Journal of Educational Research*, 19.

Steinthorsdottir, O., & Sriraman, B. (2007). Iceland and rural/urban girls- PISA 2003 examined from an emancipatory viewpoint. In B. Sriraman (Ed). International Perspectives on Social Justice in Mathematics Education. *The Montana Mathematics Enthusiast, Monograph 1,* pp. 169-178, University of Montana Press.

Steinthorsdottir,O., & Sriraman, B. (2008). Exploring gender factors related to PISA 2003 results in Iceland: a youth interview study. *ZDM- The International Journal on Mathematics Education*, 40(4), 591-600.

TUIK. (2008). Yaş grubu ve cinsiyete göre Türkiye nüfusu-2008 [Turkish population by age and gender-2008]. Retrieved on April 30, 2009 from http://www.tuik.gov.tr

Turkish Statistical Institute. (2004). *Turkey's statistical yearbook: Labor*. Ankara: TSI.

Ubuz, B., Üstün, I., & Erbaş, A. K. (2009). Effects of dynamic environment on immediate and retention level achievements of seventh grade students. *Egitim Arastirmalari-Eurasian Journal of Educational Research*, 35, 147-164.

Ubuz, B. (1999). 10. ve 11. sınıf öğrencilerinin temel geometri konularındaki hataları ve kavram yanılgıları [Misconceptions and errors of 10th and 11th graders in elementary geometry topics]. *Hacettepe Eğitim Fakültesi Dergisi*, 16-17, 95-104.

University of California. (2005). Why aren't more girls "geeks"? Retrieved on April 29, 2009 from http://www.universityofcalifornia.edu/news/article/7399