Effects Of Students Gender On Mathematics Performance In Primary Schools In Keiyo South District, Kenya

Jonah Kipsang Kiptum, Philip K. Rono, Jackson K. Too, Benjamin K. Bii, Joyce Too

Abstract: Mathematics has been viewed as a subject favouring male students due to factors like attitude, methods used for teaching and so on. This has resulted to gender differences between male and female students in Mathematics performance. The study sought to find out the relationship gender of students and mathematics performance. Descriptive survey design was used in the study to investigate the attitudes of primary school learners towards mathematics. Data was collected by use of questionnaires, interview schedules and class examination administered previously. The accessible population was teachers of Mathematics and Standard Eight learners from selected primary schools in Keiyo South District, Kenya. Sample study comprised of 300 learners (150 male students and 150 female students) and all teachers of Mathematics from the sampled schools in Keiyo South District, Kenya. Stratified random sampling was used to categorize schools in either boarding or day schools. Simple random sampling was used to select 50 schools from 119 primary schools and 5 male students and 5 female students from each selected Standard Eight class. The study used purposive sampling technique to select Mathematics Teachers. Simple random sampling technique was used to select Mathematics teachers for interview. Data was collected using questionnaire and interview schedule. It was established that majority of the students (boys and girls) had a positive attitude towards learning of mathematics. However, when comparing the attitudes of boys and girls, the results demonstrated that boys were more inclined to positive attitudes than girls.

Key Terms: Gender, Mathematics, Performance, Primary Schools

1. Introduction

Globally, mathematics has been viewed as a subject favouring male students (Gilah L. & Fennemma E, 1990). They further support the idea that there were differences between female and male students and learning of mathematics, tend to exist particularly in activities that required complex reasoning; that the differences increased about the onset of adolescence; and that the difference were recognized by many leading mathematics educators. The same experience is realized in Africa according to Africa Academy of Sciences (AAS) in collaboration with the Association for the Development of Education in Africa (ADEA) on issues of women's performance in mathematics to which it also applies to Kenya. The differences in mathematics achievement that occur in the early years are in favour of females whereas differences in mathematics achievements as well as in attitudes favouring males generally occur during the upper school years. Such differences are well documented for Britain as well as many other countries of the world. Orton (1987) asserts that:

> "Mathematics is the gate and key of science - neglect of mathematics works injury of all knowledge since he who is ignorant of it cannot view the other sciences or the things in the world"

From the foregoing, it is clear that female, like male; need mathematics in their private life, working life, socio–economic and political life of the country of which they are citizens (Cockcroft, 1993). He further asserts that:

> "Mathematics is a strategic subject in the development of science and technology and it's fundamental in the study of physical sciences and engineering of all types. It plays an important role in character building, boosting self–esteem and providing opportunities for developing curiosity and creativity. It is difficult to live in a normal life without use of mathematics of some kind"

In Keiyo South District, KCPE mathematics results for 2006 – 2011 indicate that over 80% of students have been failing in mathematics (D.E.O.'s, Keiyo South District). According to Eshiwani (1985) the declining number of female students pursuing mathematics and science courses in Kenya's institutions of learning requires some attention. The government is taking concern to end the existing imbalances in enrolment between male and female students in schools and universities. According to Cockcroft (1993), parents, teachers and peers teach us the intellectual, social, economic and cultural skills which can enable us to acquire cultural roles. According to Buxton (1984), female rate mathematics very low compared to male at the adolescent stage due to socialization patterns encountered and other factors within the school. Atieno (1991) asserts that:

> "In Kenyan schools, female tend to be channeled towards subjects such as Art,

- *Author is currently pursuing master's degree program in sociology of Education in Egerton University, Kenya*
- *Co-author is a senior lecturer, Department of Curriculum Instructional and Educational Media,*
- *Egerton University- African International College (AICO), Eldoret Town Campus, Kenya.*
- *Co-author is a senior lecturer, Department of Curriculum Instructional and Educational Media,*
- *Moi University*
- *Co-author is currently pursuing master's degree program in sociology of Education in Egerton University, Kenya*
- *Co-author is currently pursuing master's degree program in sociology of Education in Egerton University, Kenya*

> Literature and Home Science that are of more use to them in kitchen and living room than in the outside world (pg 14)"

The same findings were realized in 2011 Kenya Certificate of Primary Education (KCPE) Examination results as shown in Table 1 below.

Table 1: Summary of 2011 and 2010 K.C.P.E. Examination Overall Candidates Performance per Subject and by Gender

PAPERS	MEAN PERFORMANCE %					
	2011			2010		
	ALL	FEMALE	MALE	ALL	FEMALE	MALE
English Language	47.10	46.67	47.51	49.12	49.54	48.74
English composition	42.45	44.20	40.80	42.70	44.48	41.08
Kiswahili Lugha	41.46	41.02	41.88	52.76	52.88	52.64
KSL Objective				39.34	38.56	40.02
Kiswahili Insha	54.68	56.83	52.68	50.30	52.70	48.08
KSL Composition				25.80	24.75	26.65
Mathematics	52.18	49.94	54.28	53.80	51.34	56.06
Science	67.48	63.80	70.92	60.86	56.80	64.59
Social studies	56.32	53.41	59.07	64.93	61.88	67.73
Religious Education	62.45	61.48	63.34	60.07	59.40	60.70

Source: The Standard Newspaper P. 7 of 8/12/2011

An analysis of the Kenya Certificate of Primary Education (KCPE) examinations results shows that boys perform better in sciences and mathematics while girls out do boys in arts-based subjects and in languages. For instance, the 2011 K.C.P.E. examination results show that, boys obtained a mean score of 54.28 in mathematics as compared to 49.94 for girls; while in Kiswahili, the mean scores for boys and girls were 52.68 and 56.68 respectively. Table 4 illustrates this difference. The researcher is prompted into undertaking this study because of the fact that fewer female excel in mathematics while majority under achieve. Fewer female than male continue with the study of mathematics and related course at higher level of education, and that female are underrepresented in areas requiring certain qualification in mathematics. What seems to emerge from the foregoing is that there may be some social factors that may be influencing the attitudes that male and female students of Keiyo South District primary schools have towards mathematics and to investigate whether learners perception of peer, parental and teachers expectations influence the learners attitudes. The study seeks to establish whether or not attitudes of female students towards mathematics differ significantly from those of the male students. Attitude affects performance of mathematics. Therefore, perception plays a greater role.

Table 2: Summary K.C.P.E Performance of Boys and Girls in Mathematics 2008-2011 in Keiyo South District.

YEAR	2011		2010		2009		2008	
	Male	Female	Male	Female	Male	Female	Male	Female
Entry	683	974	562	867	550	784	520	685
% mean score	31.43	25.51	34.16	28.13	31.08	29.09	28.22	25.14

Source: DEO's Office, Keiyo South

2. Literature Review

2.1 Gender and Mathematics Performance

Various demographic factors are known to be related to mathematics achievement. Gender, socio-economic status, and parents' educational level are factors that were analyzed in this study as predictors of mathematics achievement. Many variables have long been studied as predictors of mathematics achievement. However, gender issues on mathematics achievement are studied most frequently by researchers. For instance, a study through a meta-analysis reveals that males tend to do better on mathematics tests that involve problem-solving (Hyde, Fennema, and Lamon 1990). Females tend to do better in computation, and there is no significant gender difference in understanding mathematics concepts. Another study shows that females tend to earn better grades than males in mathematics (Kimball, 1989). Some recent studies have revealed that gender differences in mathematics education seem to be narrowing in many countries. However, studies indicate that as students reach higher grades, gender differences favor increase in mathematics achievement by males (Campbell, 1995; Gray, 1996; Mullis, Martin, Fierros, Goldberg, & Stemler, 2000). For instance, the results from the Third International Mathematics and Science Study showed that mathematics achievement scores of each gender group were close to each other at the primary and middle school years (Beaton et al., 1996; Mullis et al., 1997). However, in the final year of secondary school, evidence was found for gender differences in mathematics achievement. Another study, which was conducted to analyze factors that affect mathematics achievement of 11th-graders in mathematics classes with an identified gender gap, also showed that males scored higher than females on 11th grade mathematics achievement test, but this difference decreased from 10th grade (Campbell &

Beaudry, 1998). In addition, gender differences in attitudes and perceptions of the usefulness of mathematics for middle school students were found statistically important (Lockheed, Thorpe, Brooks-Gunn, Casserly, and McAloon 1985; Oakes 1990). For example, female students show less interest in mathematics and have negative attitude toward mathematics. It is also reported that girls tend to learn mathematical concepts by means of rules or cooperative activities, while boys have a tendency to be in a competition to master mathematical concepts (Fennema & Peterson, 1985; Hopkins, McGillicuddy-De Lisi, & De Lisi, 1997). The literature on gender differences provides evidences that gender issues impact achievement in mathematics. Hence, it is crucial for educators and researchers to pay attention to gender differences in the design of mathematics instruction.

2.2 Gender Attitude towards Mathematics

Literature exists on work that has been done to compare the kind of attitudes male and female learners have towards mathematics. Belenky, Clinchy, Goldberger and Tarule, (1980) in women's ways of knowing describes a series of stages in knowing that differ in fundamental ways from how men come to know. These stages represent progression from dependence to autonomy. Learners move through five stages; silence, received knowing, subjective knowing, procedural knowing, and constricted knowing. In the silence stage, the learner accepts authority's verdict of what is true. In the receiving knowing stage, the learner learns by listening and returns the words of authority. As a subjective knower, the learners depends on what looks or feels right and what comes from his/her experience rather than an external source. The procedural knowing stage has two parts: separate and connected knowing. Separate knowers look to prepositional logic to validate argument, while connected knowers focus on the context and other people's knowledge. The final stage constructed knowing represents an effort to integrate what is known intrusively and what others know. Here the learner appreciates the complexity of knowledge. Fennemma (1977) asserts that in the classroom situation, females prefer to use a conversational styles that foster group consensus and builds ideas on top of each other, the inter – relationship of the thoughts and actions is paramount. Males, conversely, learn through argument and individual activity behaviours fostered early. Most classroom discourse is organized to accommodate male learning patterns. In addition, females are not likely to believe that mathematics has utility in their lives (Fennemma and Sherma, 1978); they see mathematics as unconnected to a relationship model of thinking. Even if they persist in taking mathematics course, females apt to find that they don't like them and liking a subject is key to succeeding at it (Lockhead et al, 1985).Since these findings were done outside Kenya, there is need to establish whether the same findings could hold true for Keiyo South District, Kenya. Gopal Rao (1973) in a survey on subject preference in secondary schools revealed that males mathematics higher up the scale than did females, though he never made any attempt to find out factors that could be influencing the nature of attitudes males and females have towards mathematics. The classroom structure, designed to foster independent non–collaborative thinking, is most supportive of white male, middle class socialization models and it continues through university (Person & West, 1991). It encourages sex–role stereotyped forms of communication, independence, dominance and assumption of leadership-in which males have been trained to excel. Women, conversely, feel uncomfortable and excluded in situation requiring such behaviour: yet, their participation-as questioners as well as newly-minted authorities may be critical to knowledge acquisition and school success. The importance that women place on mutual support, building collaborative knowledge, and applying it practically is devalued in comparison with the importance of individual expertise to males and their inclination to debate abstract concepts. Mathematics curricula often exploit the difference between males and females by drawing on their different early play experiences. Action toys for boys teach core mathematics concepts (Velocity, angles, and three-dimensional configurations) while females usually experience these concepts for the first time in a classroom. Whereas the above studies point to negative feelings towards mathematics among female but some researchers have proved wrong. They found that there is evidence on females' possession of superior or similar attitudes to those of male towards mathematics. One such evidence is from the first International Study of Mathematics Achievements (ISMA/IEA) according to their results of survey. A sample of female in England and France showed a high level of interest in mathematics than male even if it was vice versa in other continents. This led to the females' greater achievement in mathematics. The second evidence is provided by Griffiths (1974), who conducted an inquiry at primary school level into students' attitude towards mathematics using Likert-Like scale. His findings showed no difference in males' and females' attitude towards learning mathematics. Griffiths study was at primary school level, where this study is carried out. Third evidence is provided by Edward (1973) who found no difference in the attitude of male and female college students towards mathematics. His study was done in the United States. Although the findings of the above quoted studies show a general trend of gender difference in attitudes towards mathematics, Herman (1963) in Ogoma (1987) IEA (1964), Edward (1973) and Griffiths (1974) differed with the trend. According to Herman (1965), arithmetic is typically in the middle subjects, are ranked from least to most preferred by both male and female. There was therefore need to conduct this study in order to confirm or negate the findings of others. In conclusion, there seem to be gender difference in attitudes towards mathematics. From most of the reviewed studies, female students appear to have more unfavourable feelings towards mathematics than male students. Whereas this could be true, the reasons for gender difference in the attitudes advanced by the quoted study might not hold true for schools in Keiyo South District. This study apart from attempting to confirm whether the findings hold true for Keiyo South District, also intends to investigate other possible factors that could influence male and female students' attitudes towards mathematics.

3. METHODOLOGY

3.1 Research Design

The research design for this study was descriptive survey. Good (1963) defines this kind of design that descriptive studies may include present facts or current conditions, the nature of persons, a number of objects or a class of events, and may involve the procedures of induction analysis, classification, enumeration or measurement. The study adopted an ex-post facto research by using the causal-comparative design. Three types of schools were used in this study for comparison purposes. These were; mixed-sex day schools (Male and Female students in a mixed school are taught in the same stream); male boarding school and female boarding school. It is a design in which the study variables are not exposed to direct manipulation. The research study was conducted in Keiyo South District, which boarders Baringo District to the East, Koibatek District to the South, Eldoret East District to the West and Keiyo North District to the North. Keiyo South is located at the heart of the Rift Valley Province. Majority of the activities done in the district is farming and cattle keeping which is carried out by the male. These have prompted the researcher to find out why male learners perform better in mathematics than female learners. This study involved standard eight learners and mathematics teachers from the selected primary schools in Keiyo South District. Ten (10) students per school in 50 schools were targeted. The rationale of selecting these groups was to investigate the sociological factors influencing primary school learners' attitudes towards mathematics. Keiyo South District was chosen by the researcher because of its performance in mathematics. Culture is still rooted in the District hence can be the agent of change.

Table 3: Number of Research Respondents

SUBJECTS	NUMBER	RESPONDENTS	TOTAL
STD EIGHT STUDENTS	MALE = 1549	MALE 250 (16.14%)	500
	FEMALE = 1612	FEMALE 250 (15.15%)	
PRIMARY SCHOOLS	119	MALE BOARDING 15 (12.61%)	50
		FEMALE BOARDING 17 (14.29%)	
		MIXED DAY 18 (15.13%)	
STD EIGHT MATHEMATICS TEACHERS	119	MALE 25 (21.00%)	50
		FEMALE 25 (21.00%)	
TOTAL			600

Stratified random sampling technique was used to categorize the schools into either male/female boarding or mixed day schools. To select the interact group for study; the researcher used convenient and purposive sampling to select the class for research. The study used a survey involving standard eight learners and mathematics teachers of selected primary schools in Keiyo South District. Stratified sampling was used to categorize schools into male boarding schools, female boarding schools and mixed day schools. Stratification was done according to gender composition of the schools. It ensured that the three categories of schools (mixed day, female boarding and male boarding), in the ratio 18: 17: 15 was used in the sample. Purposive and convenient sampling was used to select the classes for research. Simple Random sampling method was used to select 10 students from each category of learners. Data was collected through researcher–designed questionnaire, interview schedules and class examination results administered previously. The researcher sought permission from National Council for Science and Technology (NCST) The researcher administered questionnaires and interview schedules in person to the respondents and waited for the results. The data collected was analyzed using the Statistical Package for Social Science (SPSS). Data was analyzed using descriptive statistics which involved the use of frequencies and percentages. Inferential statistics which involved use of multiple regression analysis was used to make inferences on the relationship between dependent and independent variables. It determined whether there is any significant difference between the dependent and independent variables. All tests of significance was conducted at alpha = 0.05 level. SPSS was used to aid in data analysis. Descriptive statistics to be used will be means scores, frequencies and graphs.

4. FINDINGS

4.1 The Effects of Pupils Gender on Mathematics Performance

The study from the questionnaires which were given to the pupils on the effect of pupil's gender on their performance was as summarized in Table 9, reflecting on reasons for liking mathematics and the reasons for disliking mathematics among boys and girls. Pupils like and dislike mathematics differently during the study. Comparatively, 109 (36.3%) of the female pupils wrote that they liked mathematics while 41 (13.7%) responded that they did not like mathematics. Similarly 128 (42.7%) of the male pupils wrote that they liked mathematics while 22 (7.3%) of the male pupils who responded to the question wrote that they did not like mathematics.

Table 4: Reasons of Pupils in Learning Mathematics.

	Girls	Boys
The Reasons for Liking Mathematics	**Freq**	**Freq**
Mathematics is interesting	50	60
Mathematics is my best subject	20	30
Mathematics is useful in future employment	20	30
I enjoy mathematics	10	5
Mathematics is fun	9	3
Total	**109 (36.3%)**	**128 (42.7)**
The Reasons for Disliking Mathematics		
Mathematics is boring	10	4
Some topics are difficult	10	4
Mathematics is not relevant to my future career	3	2
Learning mathematics is a waste of time	8	5
Language used in mathematics is difficult	10	7
Total	**41 (13.7%)**	**22 (7.3%)**

The main aim of studying attitudes was to help the researcher to provide teachers with results from a sample as large as possible on which they could make their own judgments. The steady decline in the girls' liking of mathematics perhaps account for the corresponding decline in their performance in the subject over the years. In almost a similar degree to the boys, the girls seem to feel that mathematics is important to their future. The boys though felt that this is their domain.

4.2 Perception on the Importance of Mathematics and their Attitudes towards Learning of Mathematics

From the study boys attitudes towards learning of mathematics reveals that 46.7% had positive attitude. On the other hand 2.4% of them had negative attitude towards learning of mathematics. Similarly, 45.7% of girls had positive attitudes, while 2.4% had negative attitudes. The findings imply that from the study most of the students had positive attitudes towards learning of mathematics.

Table 5: Perception on the Importance of Mathematics and their Attitudes towards Learning of Mathematics

Perception on the Importance of Mathematics	**Positive**		**Undecided**		**Negative**	
	Fr.	**%**	**Fr.**	**%**	**Fr**	**%**
Boys	140	46.7	3	1.0	7	2.4
Girls	137	45.7	5	1.6	8	2.6
Total	**277**	**92.4**	**8**	**2.6**	**15**	**5.0**

From the findings, it can be seen that amongst pupils who had positive attitudes, more boys than girls perceived that their peers thought mathematics was an important subject. The findings also show that there were more girls who had negative attitudes towards learning of mathematics and perceived that their peers thought mathematics was not an important subject.

5 Summary

5.1 The Effects of Pupils Gender on Mathematics Performance

Pupils like and dislike mathematics differently during the study**.** The steady decline in the girls' liking of mathematics perhaps account for the corresponding decline in their performance in the subject over the years. In almost a similar degree to the boys, the girls seem to feel that mathematics is important to their future. The boys though felt that this is their domain. The pupils' perception on the importance of mathematics accounts for the gender differences in attitudes towards learning of mathematics. From the findings, it can be seen that amongst pupils who had positive attitudes, more boys than girls perceived that their peers thought mathematics was an important subject. The findings also show that there were more girls who had negative attitudes towards learning of mathematics and perceived that their peers thought mathematics was not an important subject. The results obtained showed that majority of the students (boys and girls) had a positive attitude towards learning of mathematics. However, when comparing the attitudes of boys and girls, the results demonstrated that boys were more inclined to positive attitudes than girls. From these findings, it can be inferred that the attitudes of the respondents were dependent on their gender. In relation to their findings, it can be concluded from the responses of this study that the relevance or irrelevance of mathematics to the students' future career in the modern technological world affects their attitudes towards learning of mathematics.

6. Acknowledgement

It is with God's grace that I have been able to accomplish this study. I am greatly indebted to Egerton University especially the Graduate school, Faculty of Education and Community Studies Department of Psychology. Special thanks to African International college (AICO) Eldoret campus for the entire support accorded. I am full of gratitude to my supervisors for their scholarly attention and guidance they gave to my work. Their thoroughness, advice, availability, support and encouragement enabled me to complete the study on time. Their expertise greatly inspired me and brought my work to completion. I also wish to acknowledge the cooperation I got from the respondents, schools heads, teachers, students, education officers and the community members in Keiyo south District. My appreciation also goes to my colleagues who supported me in many ways and showed good will for me in the course of the study. The encouragement and hope we gave each other as we went through the coursework, proposal writing and finally the thesis were not in vain. Credit goes to Mr. Alfred Ngetich and Cynthia who were very instrumental in their advice, support and coordination. I thank them for their very useful support in proof reading the work. To all those who knew this work and did one think or the other that added to completion of this work are my prayers that God

may bless you richly with grace that you need to reach your destiny. My gratitude also goes to my wife, Jenifer J. Sang who with patience and self denial supported me in meeting the needs and demands of this study. My mum was always a source of inspiration in her parental support, prayers and goodwill.

References

[1]. AAUW, O (1992). *Short Changing Girls, Short Changing America: A Call to Action*,

[2]. Aiken, L.R. (1970). *Attitudes Towards Mathematics*. Review of Educational Research. Vol.40, No. 4.

[3]. Baker, D. P., & Jones, D. P. (1993). Creating gender equality: Crossnational gender stratification and mathematical performance. *Sociology of Education, 66,* 91–103.

[4]. Bosire, J. (1997). *Grim Statistics on Girls Education*, Daily Nation, March 15 P. 16.

[5]. Campbell, P. B. (1995). Redefiningthe"girlproblem"in mathematics. In W. G. Secada, E. Fennema, & L. B. Adjian (Eds.), Newdirectionsforequity in mathematics education (pp. 225-241). Cambridge: Cambridge University Press.

[6]. Fennema E & Leder G (eds)1990. *Mathematics and gender: Influences on teachers and students*. New York: Teachers college press.

[7]. Fennema E. (1981). *The Sex Factor: Real or Not in Mathematics Education*. In Fennema (ed): *Mathematics Education Research for the SOS*. Washington D.C: association for supervision and Curriculum Development,

[8]. Fennema E. and Leder C.G. (1990). *Mathematics and Gender*: Teachers College: Columbia University.

[9]. Fennema, E., & Hart, L. E. (1994). Gender and the JRME. *Journal for Research in Mathematics Education, 25*(6), 648-696

[10]. Fennema, E., & Peterson, P. (1985). Autonomous learning behavior: A possible explanation of gender-related differences in mathematics. In L. C. Wilkinson & C. B. Marrett (Eds.), *Gender influences in classroom interaction* (pp. 17-35). New York: Academic Press.

[11]. Good, Thomas L. (1987) “Teacher Expectations.“ In *Talks to Teachers,* edited by David C. Berliner and Barak V. Rosenshine, pp. 159–200. New York: Random House.

[12]. Gopal R. (1973). *A study of the Attitudes Towards Mathematics of Junior and Secondary Pupils in a New Town, and Factors Relating to Them.* Unpublished Ph D. Thesis, university of London (unpublished).

[13]. Gray, M. (1996). Gender and mathematics: Mythology and misogyny. In G. Hanna (Ed.), Towards gender equity in mathematics education: An ICMI study (pp. 27-38). Boston, MA: Kluwer Academic Publishers.

[14]. Griffiths J.L. (1974). *An Exploratory Analysis of Attitudes Towards Mathematicss Held by Student Teachers and Practicing teachers and Children in primary Schools.* M. Lit Thesis, University of Bristol (Unpublished).

[15]. Herman, C (1963): Parents Involvement in Learning of Mathematics. *Mathematics Education Research Journal* Vol. 4(**3**) pg. 45-55

[16]. Hopkins, K. B., McGillicuddy-De Lisi, A. V., & De Lisi, R. (1997). Student gender and teaching methods as sources of variability in children’s computational arithmetic performance. *The Journal of Genetic Psychology, 158*, 333-345.

[17]. Hyde, J. S., Fennema, E. H., and Lamon, S. J. (1990). Gender Differences in Mathematics Performance: A Meta-Analysis. *Psychological Bulletin 107*, 139-55.

[18]. Lockheed, M.E., Thorpe, M., Brooks- Gunn, J., Casserly, P., & McAloon, A. (1985). *Sex and Ethnic Differences in Middle School Mathematics, Science and Computer Science: What Do We Know?* Princeton, NJ: Educational Testing Service

[19]. Mullis, I. V. S., Martin, M. O., Fierros, E. G., Goldberg, A. L., & Stemler, S. E. (2000). *Gender differences in achievement: IEA's Third International Mathematics and Science Study.* Chestnut Hill, MA: Boston College.

[20]. Kimball, M. M. (1989). A New Perspective on Women's Mathematics Achievement. *Psychological Bulletin 105*, 198-214.

[21]. Oakes, J (1990). Opportunities, Achievement, and Choice: Women and Minority Students in Science and Mathematics. *Review of Research in Education 16*,153-222.