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Meta-Analysis of Research Findings on Gender Differences in Mathematics Achievement in Nigeria when Computer and Constructivist Strategies are Used

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Abstract

This study aimed at adopting meta-analytic procedures to summarize gender differences in mathematics achievement in Nigeria when computer and constructivist strategies were used. The study adopted an ex-post facto research design and the population of the study consisted of all published and unpublished research works in Nigeria on gender differences in mathematics achievement under computer and constructivist strategies. The sample of the study were thirteen (13) published and unpublished research reports sampled from ten (10) federal universities (two from each geo-political zone) and two national libraries of professional associations. The instrument for data collection was a researcher developed coding instrument with inter-rater reliability of 0.91. The data collected were analyzed using frequency tables, percentages, forest plots and effect sizes using Hedges and Olkins statistical approach. The findings revealed among other things that the studies on constructivist strategy had a medium mean effect of-0.21 which favoured the female students while the computer strategy had a small mean effect of 0.14 which favoured the male students. The overall effect size for the thirteen research findings was negative and very small. Implying that when the research findings were combined, it was discovered that the female students did slightly better than their male counterparts. Based on the findings, it was recommended among other things that mathematics teachers should vary their teaching strategies to adequately take care of both male and female students.

In earlier times, the concept of teaching strategy was mainly identified with teachers' activity of giving information to students. However, in recent times, additional meanings have been added to this concept, thus broadening its content. Thus

for this research study, the definition of teaching strategy given by Toohey (2000), as all the activities, processes, and resources that a teacher plans and executes in order to enable students to learn and for t he achievement of a particular educational purpose is adopted. Some of these strategies are exploratory or activity based in nature and they include computer based strategies and constructivist strategies.

A computer is a machine that processes input data in accordance with programme of instructions stored within and provides the results in useful form (Inkang, 2002). Gallo and Neno (1989) further stated that the computer can process not only mathematical calculations, but can also sort, store and retrieve data. The computers according to Nwosu (1998) are applied in education in so many ways which include: Computer assisted instruction (CAI), computer managed instruction (CMI), computer supported learning (CSL), Computer Scheduled instruction (CSI), Computer Based Learning (CBL), Computer augmented teaching (CAT). The CAI which refers to the use of the computer on a time-shared basis to perform any instructional function appears to be the most popular application of computer in education.

Constructivist strategy sees knowledge as being actively constructed by the learner on the ground of constructs already available to him/her and that learning is likely to occur if the facts to be learned are constructed by the learner as having personal relevance or meaning. The strategy emphasizes that learning should entail activities directed at processing the new material or topic, linking it to what the student already knows. The tasks should be authentic, set in a meaningful context, and related to the real world (Petty, 2012). Many instructional strategies are embedded within this such as concept mapping, vee mapping etc.

Several researchers have applied these strategies in teaching different mathematics topic at different levels of the education system with the aim of determining their relative effectiveness. For instance Ogbonna (2007) studied the effect of two constructivist instructional models on Junior Secondary II students' achievement. Nwankwo (2006), studied the effects of computer tutorial programme on students' achievement in mathematics.

Moreover some psychological studies have shown that gender as a variable relates to achievement. Thus many of the research studies like that carried out by Nwankwo, (2006) and Ogbonna, (2007), have tried to investigate into the differential effect of teaching strategies on the achievement of boys and girls, so as to find out which of these strategies would help to improve the achievement of either the boys or the girls. Results of these studies, which are sometimes inconsistent, are scattered in many literature, thus the need to have an objective summary about the research findings becomes a major focus of this research work.

The only way of arriving at such objective summary according to Ajuar (2006), is to integrate the results of the various studies in order to provide a composite view. This can be achieved through a meta-analysis. Meta-analysis according to Glass (1976) is the application of a set of statistical procedures to the collections of empirical findings from individual studies for the purpose of integrating, synthesizing and making sense of them. It entails using objective methods to find studies for a review, describing the study features quantitatively, expressing treatment effects of all studies on common scale of effect size and using statistical techniques to relate study features to study outcomes. The procedures for conducting a meta-analysis include the voting method, the effect size method, combined probability method, study effect meta-analysis, psychometric meta-analysis etc. In essence, this research study was undertaken with the aim of adopting meta-analytic procedures to summarize gender differences in mathematics achievement in Nigeria when computer and constructivist strategies where used.

Purpose of the Study

The study aimed at finding out

1. The results of the previous studies on gender differences in mathematics achievement under the use of computer and constructivist strategies.
2. The effect size for each of the studies examined.
3. The overall effect size for all the studies examined.
4. The variation of effect size with computer and constructivist strategies.
5. The variation of effect size with junior secondary and senior secondary school levels.

Research Questions

1. What are the results of the previous studies on gender differences in mathematics achievement under the use of computer and constructivist strategies?
2. What is the effect size for each of the studies examined?
3. What is the mean effect size for all the studies examined?
4. How does the effect size vary with computer and constructivist strategies?
5. How does the effect size vary with school levels (Junior Secondary and Senior Secondary level)?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance.

1. The overall or mean effect size of all the studies examined is non-significant.
2. The mean effect of the indices of teaching strategies (computer and constructivist) on gender differences in students' academic achievement in mathematics is non-significant.
3. There is no significant gender difference in the mean effect of the two strategies on students' achievement in mathematics based on school levels.

Method

This study adopted an ex-post facto research design. The area of the study is Nigeria consisting of six geo-political zones. The population of the study consisted of all the published and unpublished research works which measured gender differences in mathematics achievement under computer and constructivist strategies. Published works are located in journals, books of readings, and conference proceedings. Unpublished works refer to Ph.D dissertations, masters' thesis and first degree projects. These published and unpublished works must have been carried out in Nigeria between 1990 and 2010. The source of these materials were all the 26 federal universities, 32 state universities and 33 private universities as well as libraries of professional associations that promote mathematics teaching and learning in Nigeria.

The samples of this study were 13 (thirteen) published and unpublished research reports. To obtain the studies used in this study, federal universities were purposively sampled because it is believed that a wider coverage was given in the admission of students. As such the students were more likely to use samples from different parts of the country in carrying out their research works. Also a greater number of the state and private universities had not been established as at 1990. From the 26 federal universities, two universities were randomly sampled from each of the six geo-political zones of the country.

However, it was only possible to visit one university each from the North-East and North-West zones due to the security challenge facing the country as at the time of this research. The ten universities visited are: University of Lagos, University of Ibadan, University of Port Harcourt, University of Uyo, University of Nigeria Nsukka, Nnamdi Azikiwe University Awka, University of Jos, Federal University of Technology Minna, Ahmadu Bello University Zaria, and Ado Bayero University Bauchi. University of Benin was visited, but was not eventually used.

In addition, libraries of science teachers association of Nigeria and mathematical association of Nigeria were also visited. After sampling these universities and libraries, all the studies in them that fell within the scope of the study and which could be identified by the researcher were used for the study.

The instrument for data collection was a researcher developed coding instrument with fourteen (14) columns including:- serial number, name of author, year of study, area of study, type of publication, level of students, subject area, sample size, type of achievement test, index of teaching strategy, indicator of teaching strategy, statistical method used, result of analysis, effect size. This instrument was validated by two experts in educational measurement and evaluation and one in science education. An inter-rater reliability of 0.91 was determined for the instrument from the rating of

two independent observers. The studies collected were then coded by the researcher based on the columns/sections of the research instrument.

The data collected were analyzed using frequency tables, percentages, forest plots, statistical transformations, effect size using Hedges and Olkins (1985) statistical approach. The effect size is the mean difference between the groups in standard score form. This can be interpreted as follows (Borenstein, Hedges, Higgins and Rothstein, 2009).

$g < 0.2$ – small effect
$0.2 \leq g \leq 0.50$ – medium effect
$g > 0.50$ – large effect.

Hedges and Olkin's effect size approach was also used to test the hypotheses at 0.05 level of significance.

Result

Research Question One

What are the results of the previous studies on gender differences in mathematics achievement under the use of computer and constructivist strategies?

Table 1: Summary of the Results of the Studies Examined

Index of teaching strategy	**Total Nos. of cases**	**Statistically significant cases**				**Statistically non-significant cases**			
		No. of males	% of total Nos. for males	No. of females	% of total Nos. for females	No. of males	% of total Nos. for males	No. of females	% of total Nos. for females
Computer assisted instruction	6	1	7.69	0	0	4	30.76	1	7.69
Constructivists trategies	7	0	0	4	30.76	3	23.08	0	0
Total	13	1	7.69	4	30.76	7	53.84	1	7.69

Table one shows that thirteen (13) studies altogether were examined. Six (6) as computer assisted instruction and seven as constructivist strategies. For computer assisted strategies, 1(7.69%) of the findings was statistically significant while 5 (38.45%) yielded results that were not statistically significant. For constructivist strategies, 3 (30.76%) were statistically significant, while 3 (23.08) of the findings were non-significant. On the whole 5 (38.45%) of the results were statistically significant while 8(61.53%) yielded results that were not statistically significant. Also for the

statistically significant cases, one was in favour of the males and four was in favour of the females while for the non-significant cases seven was in favour of the males and one in favour of the females.

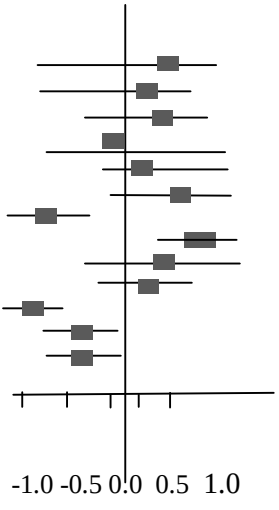
Table 2: Proportions of Significant and Non-Significant Results of Gender Performance among the Two Teaching Strategies Examined

		Significant Results		Non-Significant Result	
Index of teaching	**Total Nos of cases**	**Nos**	**% Number of index of teaching strategy**	**No**	**% Number of index of teaching strategy**
Computer assisted instruction	6	1	16.67	5	83.53
Constructivist strategy	7	4	57	3	43

Table 2, reveals that the constructivist strategy had the highest proportion (57%) of significant results of gender performance, while for the computer assisted packages, a greater proportion of the results were not significant.

Research Question 2: What is the Effect Size for each of the Studies Examined?

Names	**Effect size (g)**	**Relative Weight (%)**
Odogwu	0.215	1.02
Etukudo	0.094	1.67
Udegbe	0.10	2.3
Etukudo & Utin	-0.133	1.02
Nwankwo	0.086	2.13
Moffat	0.411	2.0
Okoli	-0.841	2.34
Ezeugo & Agwagah	0.825	2.52
Anyamene & Anyachebelu	0.192	1.63
Ogunkunle	0.077	3.06
Offiah & Okoli	-0.836	2.34
Ogbonna (a)	-0.456	2.28
Ogbonna (b)	-0.446	2.25



_____confidence interval
Area of the box = Relative weight
Centre of the box = location of effect size
Fig 1 of Forest plot using boxes to represent the effect sizes and relative weight of the 13 studies examined.

From the forest plot in Fig 1 it can be observed that five of the boxes fell on the left hand side of the cente. These boxes represent those studies that had negative effect sizes in which the female students performed significantly better than their male counterparts. The other eight studies had positive effect sizes representing studies in which the male students performed better than their female counterparts. The forest plot revealed the confidence intervals which bounds each of the effect sizes. These confidence intervals are used to show precision, with a narrower interval reflecting better precision and more study weight. From the plots, the study by Ogunkunle had the narrowest confidence interval while the study by Etukudo and Utin had the widest confidence interval.

Table 3: Summary Table for the Calculated Effect Sizes

Index of teaching strategy	**Positive small effect sizes**	**Positive medium effect sizes**	**Positive large effect sizes**	**Negative small effect sizes**	**Negative medium effect sizes**	**Negative large effect sizes**
Computer packages	3	2		1	-	-
Constructivist strategy	2		1		2	2
Total	5 (38.5)	2 (15.4%)	1(7.7%)	1(7.7%)	2(15.4%)	2(15.4%)

Table 3 reveals that from the effect sizes calculated, six (6) had small effects, four (4) had medium effects and three (3) had large effects. A further breakdown shows that of the six small effect sizes, five (38.5%) of them were positive (in favour of male students) while one (7.7%) was negative (in favour of female students). Of the four medium effect sizes, two (15.4%) of them were positive (in favour of male students) while two (15.4%) were negative (in favour of female students). Of the three large effect sizes, one (7.7%), was positive (in favour of male students) while two (15.4%) were negative (in favour of female students).

Research Question 3: What is the Mean Effect Size for all the Studies Examined?

The goal here is to estimate the mean of the distribution of effects in a range of studies so that the overall estimate is not overly influenced by any single study. The Hedges effect size approach was adopted for this purpose.

Table 4: Mean Effect Size And 95% Confidence Interval Associated with all the Studies Examined

Total Nos of cases	∑Weight ∑W*	Weight x effect size ∑W*y	Summary effect M*	Variance Vm*	Standard Error SEm*	Confidence Intervals LLm*	ULm*
	47.13	-3.072	-0.08	0.02	0.14	-0.35	0.19

Table 4 shows that the computed value of the summary effect or weighted mean effect for all the thirteen (13) findings analysed is -0.08. This represents a very small effect. Also this value is negative indicating that the mean magnitude of gender difference in achievement in mathematics is small and in favour of the female students. The table also reveals that the 95% confidence interval or precision which addresses the level of accuracy of the mean effect as an estimate of the true effect is from -0.35 to 0.19. This interval is narrow, showing good precision.

This is further illustrated on the forest plot in fig 2.

Names	**Effect size (g)**	**Relative Weight (%)**
Odogwu	0.215	1.02
Etukudo	0.094	1.67
Udegbe	0.10	2.3
Etukudo & Utin	-0.133	1.02
Nwankwo	0.086	2.13
Moffat	0.411	2.0
Okoli	-0.841	2.34
Ezeugo & Agwagah	0.825	2.52
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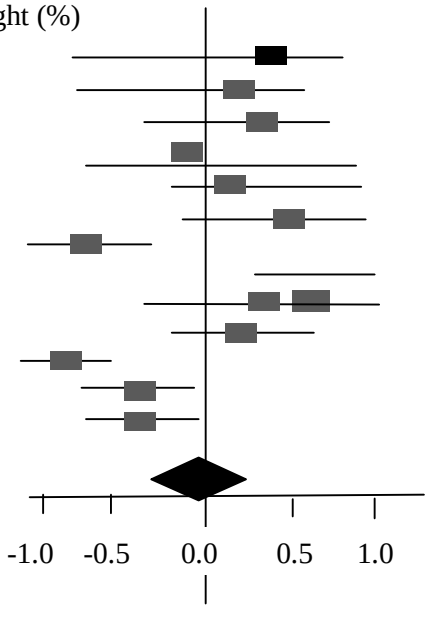
Ogunkunle	0.077	3.06
Offiah & Okoli	-0.836	2.34
Ogbonna (a)	-0.456	2.28
Ogbonna (b)	-0.446	2.25



_____confidence interval
Area of the box = Relative weight
Centre of the box = location of effect size
Fig 1 of Forest plot using boxes to represent the effect sizes and relative weight of the 13 studies examined.

The summary or mean effect size is represented by the diamond shape on the last line of the plot. The center of the diamond depicts the mean effect size, while the width of the diamond depicts its confidence interval. The center of the diamond is located on the left hand side of the plot very close to the zero line which shows that the summary effect size of the studies is small and negative in favour of the female students.

Research Question 4: How does the effect size vary with computer and constructivist strategies?

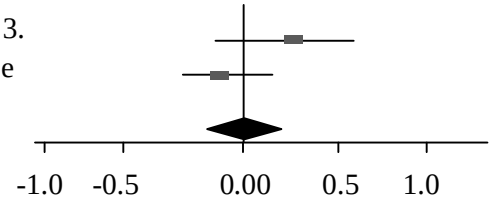
Table 5: Mean Effect Size Associated with Computer and Constructivist Strategies

Type of teaching strategy	Nos of cases	∑Weight ∑W*	Weight x effect size ∑W*y	Mean effect size M*	Variance Vm*	Standard Error SEm*	Confidence Interval LLm*	ULm*
Computer packages	6	20	2.8	0.14	0.05	0.23	-0.304	0.584
Constructivist strategies	7	27.78	5.83	-0.21	0.036	0.19	-0.58	0.16
Total	13	47.13	-3.072	-0.08	0.02	0.14	-0.35	0.19

Table 5 reveals that the mean effect size associated with the computer packages is 0.14. This is a small and positive effect which implies that male students achieved slightly better than the female students. The mean effect size for the constructivist strategies is -0.21. This is a negative and medium effect which implies that the female students achieved better than their male counterparts.

This is further illustrated on the forest plot in fig 3.

Study	g	Variance
Computer	0.14	0.05
Constructivist	-0.21	0.036



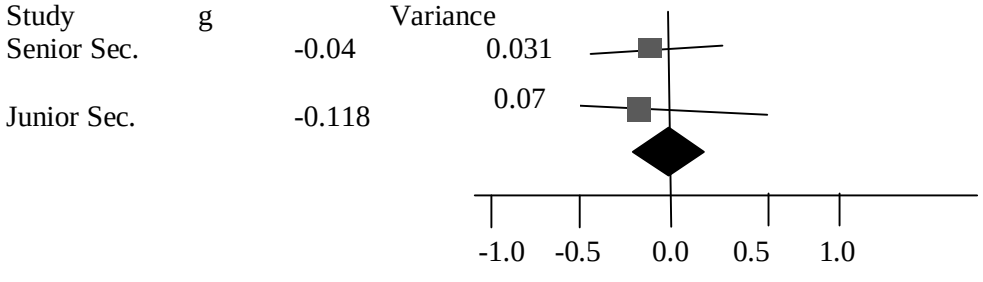
The forest plot shows that the studies on computer strategies have the box representing their effect sizes on the positive side while the studies on constructivist strategies have the box representing their effect sizes on the negative side.

Research Question 5: How does the effect size vary with the junior and senior secondary levels.

T/able 6: Mean effect sizes associated with Junior and Senior Secondary Levels

School Level	Total Nos of cases N	∑Weight (∑W*)	Weight x Effect size (∑W*y)	Summary Effect size M*	Variance Vm*	Confidence Interval LLm*	ULm*
Senior secondary	10	32.41	-1.34	-0.04	0.031	-0.38	0.304
Junior secondary	4	14.72	-1.73	-0.118	0.07	-0.63	0.39
Total	14	310.773	-12.538	-0.08	0.02	-0.35	0.19

Table 6 reveals that the mean effect sizes of the senior secondary and junior secondary levels were -0.04 and -0.118 respectively. These all represent small and negative effects. This implies that for the two levels used in the different studies, there was a slight effect of treatment in favour of the female students. This is further illustrated on the forest plot below.



Hypothesis 1: The overall or mean effect size of all the studies examined

Table 7: A Z-Test of the Null Hypotheses for All the Studies at 0.05 Level of Significant

Mean Effect Size	Variance	Standard Error	Lower confidence interval	Upper confidence interval	Z-value	Prob	Decision
-0.08	0.02	0.14	-0.35	0.19	-0.57	0.569	Accept

From table 7, the calculate Z-value is 0.57 and the p-value associated with this Z-value is 0.569. Since 0.05 is set as the criterion for statically significance, we fail to reject the null hypothesis. This implies that there is small but non-significant gender effect in favour of the female students.

Hypothesis Two: The mean effect of the two indices of teaching strategies (computer and constructivist) on gender differences in students' academic achievement in mathematics is non-significant.

Table 8: Table Summary of Random Effects Model (Pooled Estimate of T^2) For the Indices of Teaching Strategies

	SUB GROUPS		
Calculated values	Computer	Constructivist	Combined
Mean Effect Size	0.14	-0.21	-0.08
Variance	0.05	0.036	0.02
Standard Error	0.23	0.19	0.14
Lower confidence Interval	-0.304	-0.58	-0.35
Upper confidence Interval	0.584	0.16	0.19
Z-value	0.61	-1.11	-0.57
P-value	0.542	0.267	0.569
Decision	Accept	Accept	Accept

Table 8 shows that for the computer strategies, the mean effect size of 0.14 has a Z-value of 0.61 with an associated probability of 0.542. Thus this mean effect size is non-significant at a 0.05 level of significance. For the constructivist strategy, the mean effect size of –0.21 has a Z-value of –1.11 with an associated probability of 0.267. This mean effect size is thus non-significant. In general, the two strategies considered, had no significant gender difference in achievement in mathematics at a 0.05 level of significance.

Hypothesis Three: There is no significant gender difference in the mean effect of the two strategies on students' achievement in mathematics based on school levels.

Table 9: Summary of Random Effect Model with Pooled Estimate of T^2 by School Levels

	SUB GROUPS		
Calculated Quantities	Senior Secondary	Junior Secondary	Combined
Mean Effect Size	-0.04	-0.118	-0.08
Variance	0.031	0.07	0.02
Standard Error	0.176	0.26	0.14
Lower confidence Interval	-0.38	-0.63	-0.35
Upper confidence Interval	0.304	0.39	0.19
Z-value	-0.227	0.45	-0.57
P-value	0.81	0.65	0.57
Decision	Accept	Accept	Accept

Table 9 reveals that for the senior secondary school level, the mean effect size of –0.04 has a Z-value of –0.227 with an associated probability of 0.81. This mean effect size is negative, small and non-significant at 0.05 level of significance. For the junior secondary level, the mean effect size of –0.118 has a Z-value of 0.45 and an associated probability of 0.65. This mean effect size is also small, negative and non-significant.

Discussion of Results

The findings of this research are discussed in four sections which are:-

a. Results of the individual studies.
b. Effect sizes of the studies.
c. Mean effect size of the studies.
d. Variation in effect sizes associated with

The indices of teaching strategies
The school levels

Results of the Individual Studies

Thirteen (13) research findings on gender differences in mathematics achievement in Nigeria when computer and constructivist strategies are used were sampled and used in this meta-analysis. The results of these individual studies indicated greater number of statistically non-significant findings 61.53% compared to 38.45% of statistically significant findings. For the non-significant findings 1 (7.69%) were in favour of female students while 7 (53.84%) were in favour of male students. Of the significant cases 4(30.76%) indicated those statistically significant in favour of the females while 1(7.69%) indicated those statistically significant in favour of the males.

Thus, it is observed that although the males had higher mean achievement scores in 8 of the findings as against 5 for the females, they were mostly non-significant. This non-significant finding tells us that the null hypothesis of no difference between the group means could not be rejected. Ingraham (2011), stated that statistical significance is a technical term which simply tell us that the result of the study probably isn't a fluke. In essence for the greater number of the findings, the observed gender difference in mean achievement scores is not a real difference.

However Schuele and Justice (2006), stated that statistical significance is not enough to be depended upon as the only basis for measuring the noteworthiness of research because it does not reveal the magnitude or strength of a relationship. Schuele and Justice thus suggested the use of effect sizes to further interpret the practical import of statistical results.

Effect Sizes of the Results

The effect sizes, relative weights and confidence intervals of the research findings are shown on the Forrest plot in figure 1. The thirteen (13) research findings gave rise to a total of thirteen (13) effect sizes. It is observed from figure 1, that different effect sizes were obtained for the individual studies and this ranged from 0.077 to 0.841. This means that the strength of the variables differed from one study to another.

Table 3 further reveals that out of the thirteen effect sizes, there were three (3) large effect sizes, two (2) in favour of females and one (1) in favour of males, four (4) medium effect sizes, two (2) in favour of females and two (2) in favour of males, six (6) small effect sizes, five (5) in favour of males and one (1) in favour of females. The determination of these effect sizes therefore went a step further to characterize the results in a more functional way by discussing the magnitude of the effects in addition to the estimates of probability and confidence interval. This is quite unlike the number of significant and non-significant findings. Thus Neil (2006) emphasized that when looking at treatment effects using small sample size, significance testing can be misleading because it is subject to type 11 errors. On the contrary looking at treatment effects using large samples, significant testing can be misleading because even trivial treatment effects are likely to produce statistically significant results. Neil (2006) therefore recommended that effect sizes and their confidence intervals should be reported in addition to statistical significance to make for more meaningfulness.

Mean Effect Size of the Studies

From table 4, the mean effect size calculated for the thirteen cases examined is –0.08. This represents a very small and negative effect. However from hypothesis 1 and table 7, it is observed that this mean effect size is non-significant. In essence, the

magnitude of difference in achievement in mathematics based on gender is very small and favours the female students. This situation is contrary to the much emphasis placed on male dominance in mathematics and related disciplines. Bassey et al (2012) had earlier stated that the type of gender roles given to male students, tend to give them an intellectual edge over their female counterparts, but this assertion is contrary to the findings of this study. On the other hand, the result of this study supports the findings of Hyde, Fennema and Lamon (1990) who established small but significant gender difference in favour of the female students.

It should be noted that from the results of the study presented in table 1, the male students had higher mean achievement scores in eight (8) of the studies as against five (5) for the females. However, the magnitude of the effect sizes calculated for each of the five studies favouring female students seemed to be greater than the effect sizes for most of the other eight studies. This may have accounted for the overall mean effect size being in favour of female students. This mean effect size is not significant which implies that the difference in mathematics achievement which favoured female students could be over looked. It could be attributed to chance.

Variation in Effect Size Associated with the Type of Teaching Strategy Used

Results on table 5 and 8 shows that there is variation in the mean effect sizes associated with the various indices of teaching strategies (computer and constructivist) examined. A medium mean effect of –0.21 was obtained for the studies on constructivist strategies while a small mean effect size of 0.14 was obtained for computer based strategies. The constructivist strategy had mean effect size that favoured the female students. This implies that when the studies were accumulated based on the different strategies, the female students performed quite higher than the male students under the constructivist strategy. This may be because this strategy allows students to actively make sense out of new experiences and discourages abstract learning, which tends to favour male students. Constructivist strategy enables students to learn how to learn and not passively memorize what they are told. On the other hand computer strategies tend to require higher intellectual and abstract reasoning and this tend to favour male students. Howes (2002) and Sinnes, (2005) had earlier stated that females will produce the same scientific knowledge as male subjects, once enough exposure and rigour are given in scientific inquiry and external obstacles due to political, educational and social factors are removed. This variation was however found not to be significant, table 8. Thus although the male and female students performed differently under the two strategies, the variation in achievement is not significantly based on the type of teaching strategy adopted. This means that despite the assertions of Fennema et al (1998) that there were gender differences in strategy use, such differences do not significantly cause variations in the achievement of both female and male students in mathematics.

Variation in Effect Size Associated with the School Level

From table 6, it is observed that there were slight variations in the effect sizes of the two school levels considered. The senior secondary level had a lower mean effect size of –0.04 followed by the junior secondary level with a mean effect size of –0.118. These effect sizes are all very small in magnitude and negative in direction, which means that they favoured female subjects. By implication, the female students performed better at the lower level than at the higher level. This may be because at the lower level of schooling, the effects of sex-stereotyping and environmental provisions pointed out by Bassey et al (2012) and which tend to favour male students may not have become quite pronounced. Lonsdale (1969) had earlier stated that the feelings about women's roles and marriage, which tend to hinder the aspirations and higher achievements in science are not very noticeable at the primary level. The findings of this study agrees with the findings of Friedman (1989) who discovered that the average gender gap is very small and tended to decline with time as the school level increased although it was in favour of male students.

The result of the test of hypothesis 3 (table 9), reveals that the mean effect sizes for the two school levels were not significant. This implies that although the female students performed slightly better than the male students at the two levels, the difference in achievement may be due to chance and can be overlooked.

Conclusion

The following conclusions could be drawn from the meta-analysis of thirteen (13) research findings on gender differences in mathematics achievement in Nigeria based on the use of computer and constructivist strategies.

1. There were greater number of statistically non-significant findings.
2. In general, the males had higher mean achievement scores in 8 of the findings as against 5 for the females.
3. The individual effect sizes calculated ranged from 0.077 to 0.841.
4. Studies favouring female students had larger effect sizes than studies favouring male students.
5. The overall or mean effect size for the thirteen (13) research findings was very small (-0.08) and negative (in favour of female students).
6. The overall or mean effect size of –0.08 was non-significant.
7. There was variation in the mean effect sizes associated with the two teaching strategies observed. The constructivist strategy had a medium mean effect of –0.21 which favoured the female students while the computer strategy had a small mean effect of 0.14 which favoured the male students.
8. The mean effect sizes associated with the teaching strategies were non-significant.

9. There was variation in the mean effect sizes associated with the school levels. – 0.04 for senior secondary and –0.118 for junior secondary. Both were small and negative, in favour of female students.
10. The mean effect sizes associated with the two school levels were non-significant.

Recommendations

The following recommendations are made based on the above results.

1. Researchers should be encouraged to report effect sizes in addition to statistical significance so as to make research findings clearer, meaningful and functional.

2. Mathematics teachers should vary the teaching strategies adopted in mathematics lessons to adequately take care of both male and female students.

3. Conducive classroom environment devoid of all forms of gender stereotyping should be provided by the teacher.

4. Teacher educational institutions should ensure that teachers in training are exposed to adequate teaching strategies, skills and experiences which will enable them to help both male and female students improve their mathematics achievem

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Appendix 1

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